IN THIS ISSUE:

FIRE WITHOUT FIREMEN
GAS ENGINE VERSUS STEAM ENGINE

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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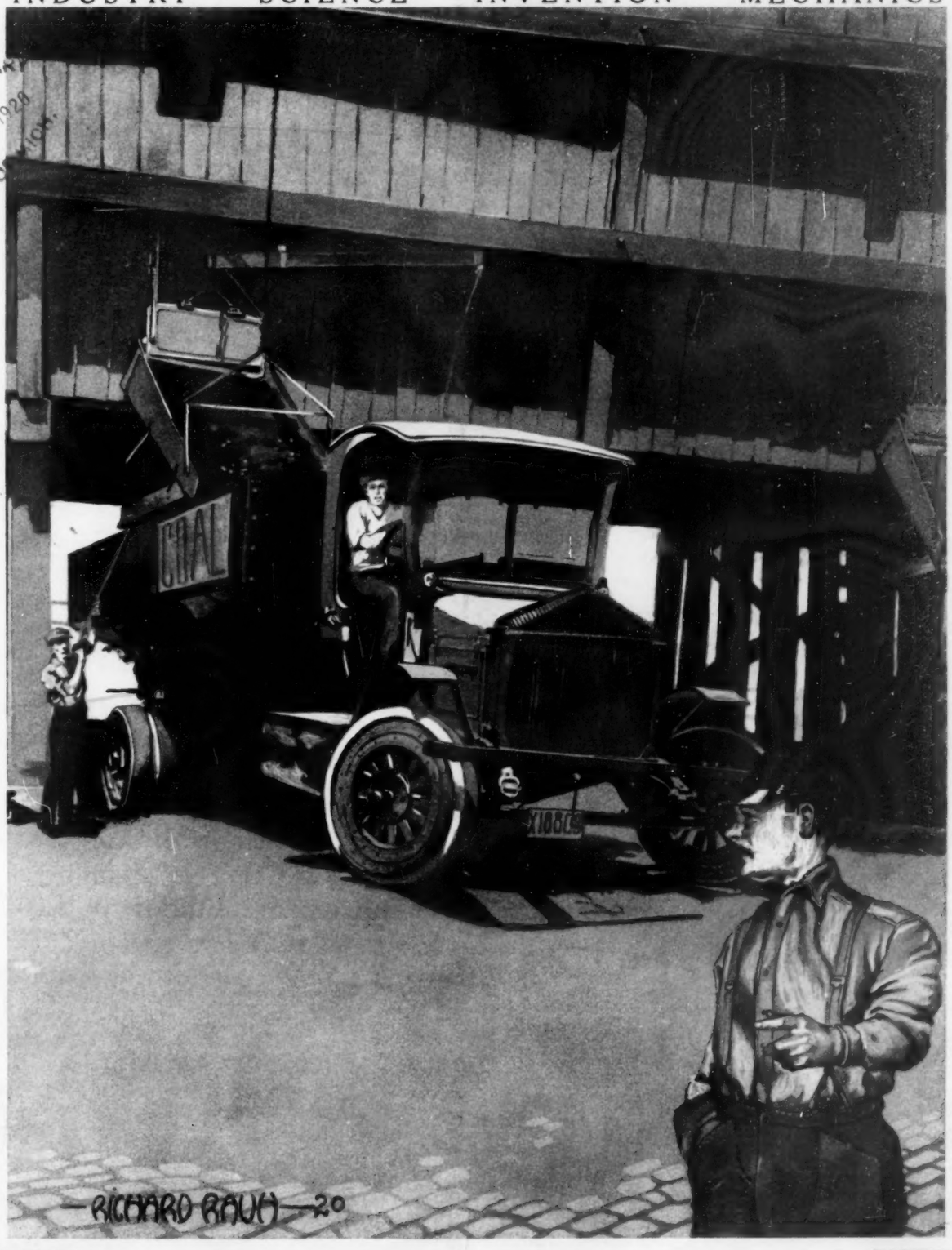

SPEEDING UP COAL DELIVERY WITH THE MOTOR TRUCK.—[See page 197]

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August 28, 1920

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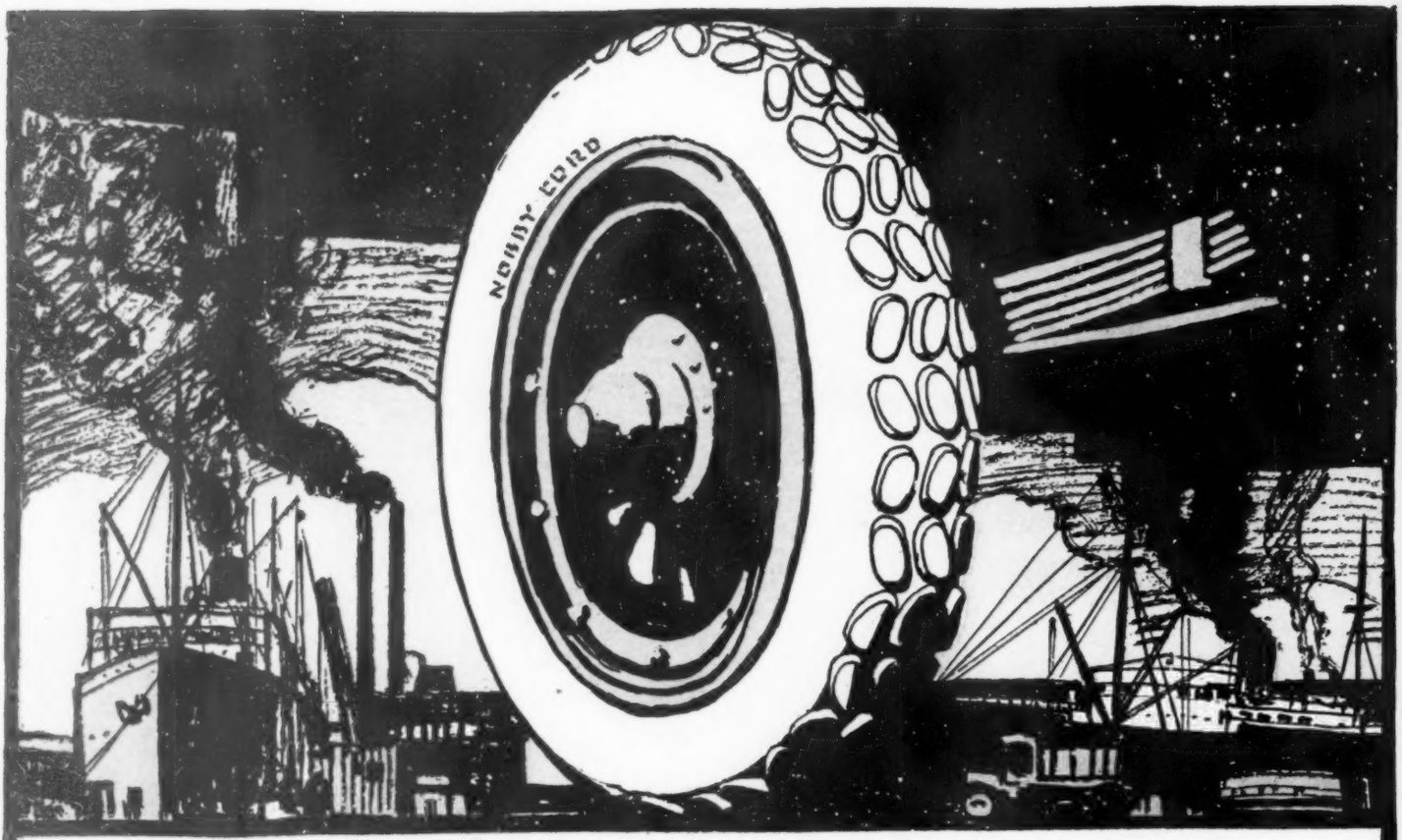

A NEW TRANSPORTATION ERA-
BUT WHAT KIND OF PNEUMATIC TRUCK TIRES

NINE years ago, there were only about 25,000 motor trucks in the country. That was when *the first pneumatic truck tire ever built* came out of one of the U. S. Tire factories.

How changed today. More than 700,000 trucks. Over 5,000 truck *lines*, paralleling the service of the railroads. More starting daily.

The United States Rubber Company has long been preparing for this new transportation era. Looking ahead—realizing the part the *right kind of pneumatic truck tires* should play. Thinking of the *food* situation, the *industrial* situation—*every* phase of commercial transportation.

Its years of experience—longest of any truck tire manufacturer—have been devoted to this one objective: the construction of a *Truck* Pneumatic built for *Truck* service. With the result that it has been able to incorporate, in each U. S. Nobby Cord Pneumatic Truck Tire, a structural strength beyond anything ever attempted—as may be seen from the way its beads are *anchored*, its breaker strips *multiplied*, its flap *moulded*, its side cushions *bulwarked*, its holding to the road *made sure*.

* * *

The United States Rubber Company is providing truck owners *today* with the pneumatic truck tire performance they will be looking for when the *bulk* of the nation's freight business is being done by motor truck.

U.S. Pneumatic Truck Tires

United States Rubber Company

Fifty-three Factories

The oldest and largest Rubber Organization in the World

Two hundred and thirty-five Branches

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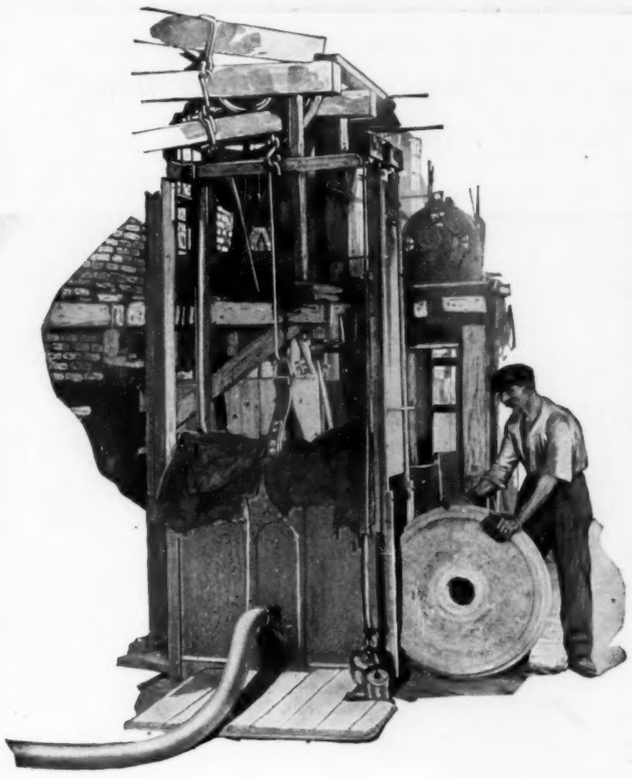


Rainbow Sand Blast Hose

Lasts Longer Than the Iron Nozzle

IN twenty-four hours a day service, under eighty pounds working pressure, Rainbow Sand Blast Hose showed a daily cost of fifteen and a fraction cents per length. Ordinary sand blast hose, at the same plant and under identical conditions, showed a daily cost of sixty-seven cents per length.

Rainbow Sand Blast Hose has repeatedly outworn heavy iron nozzles. Its special pure gum tube resists injury and abrasion from sand far better than any other tube.

A flexible four-ply body safeguards Rainbow Sand Blast Hose against sharp bends, kinks and the distortion of the tube—preventing severe wear at the bends.

The complete line of United States Hose includes a type and style of hose especially designed for every service.

United States Rubber Company

1790 Broadway New York City

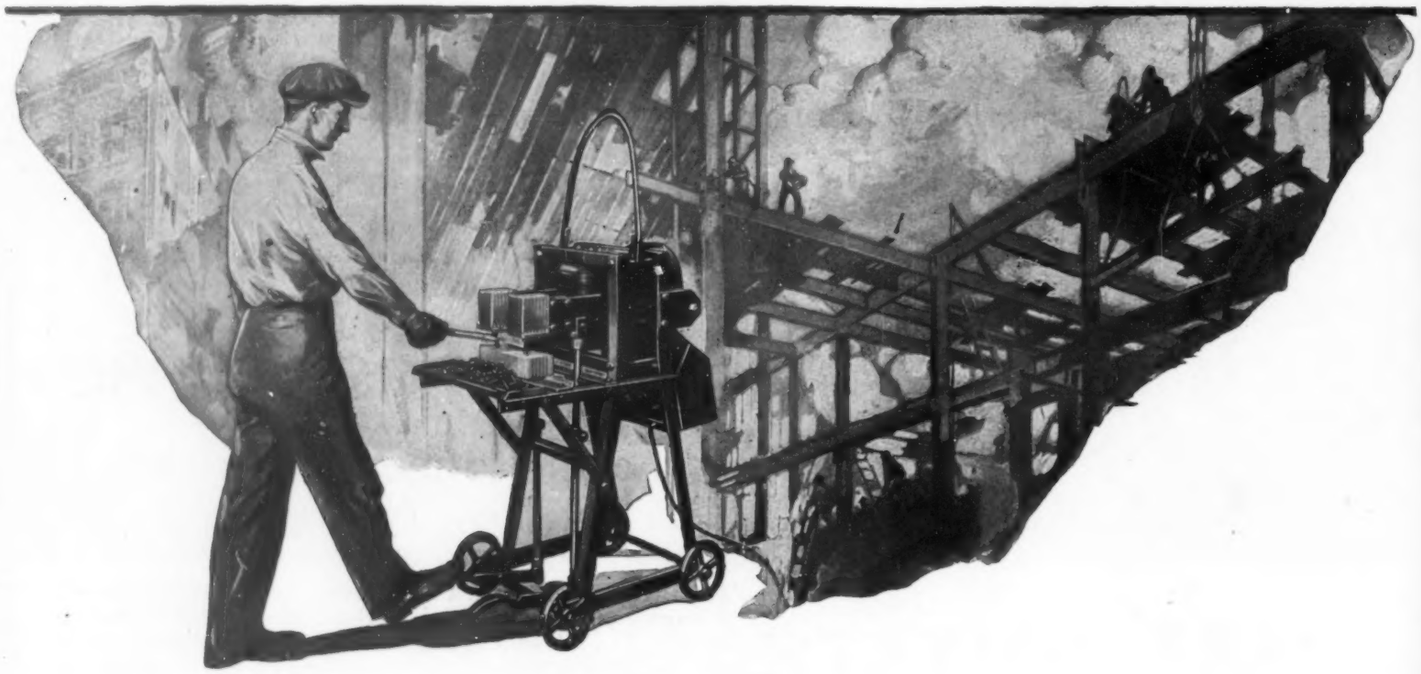
The World's Largest and Most Experienced Manufacturer of Mechanical Rubber Goods

BELTING	HOSE	PACKINGS	MISCELLANEOUS
Transmission *"Rainbow," "Pilot" "Shawmut"–"Giant Stitched"*	**Air** *"4810," "Dexter"*	**Sheet** *"Rainbow," "Vanda," "Paramo*	Mats, Matting and Flooring
Conveyor *"United States," "Grainster"*	**Steam** *"Rainbow," "Giant," "Perfected"*	**Rod** *"Wizard," "Rainbesta," "Peerless," "Honest John," "No. 573" and hundreds of other styles in coils, rings, gaskets and diaphragms—*	Plumbers' Specialties,
Elevator *"Matchless," "Granite," "Grainster"*	**Water** *"Rainbow," "Mogul," "Perfected"*	**Usco Valves—**	Rubber Covered Rolls,
Tractor *"Sawyer Canvas" "Little Giant Canvas"*	**Suction** *"Amazon," "Giant"*	THE RIGHT PACKING IN THE RIGHT PLACE	Friction Tape, Splicing Comp'd,
Agricultural *"Rainbow," "Bengal" "Grainster," "Sawyer Canvas"*	**Garden** *"Rainbow," "Mogul," "Lakeside"*		Dredging Sleeves,
	Also Hose for Acetylene, Oxygen, Acid, Air Drill, Auto Radiator, Car Heating, Air Brake, Gasoline, Oil, Hydraulic, Chemical, Coke, Creamery, Discharge, Vacuum, Sand Blast, Spray, etc.		Hard Rubber Goods,
			Printers' Blankets, Tubing,
			Soles, Heels, Jar Rubbers, Moulded Goods

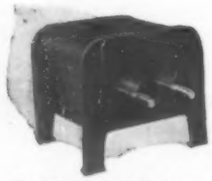
UNITED STATES RUBBER COMPANY AND ASSOCIATED COMPANIES — US RUBBER SYSTEM

THE SCIENTIFIC AMERICAN. August 28, 1920. Volume 123, Number 9. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

Among the many benefits derived from forced production of war time, there is none more lasting or more promising than electric heat

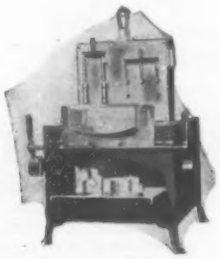


800 Red Hot Rivets per Hour



Soldering iron muffle furnace

Electric soldering iron



Muffle type heat treating furnace

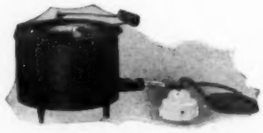
WHILE the nation's shipbuilding program was in full swing, every day demanded rivets, more rivets and still more rivets. And the electric rivet heater helped shipbuilders to establish records that are now history.

This portable heater was carried to every corner of the ship, connected to a wire, and in a few seconds red hot rivets were supplied at a rate as high as 800 per hour, depending upon the size. No coal, no dirt, no cinders to bother with, no smoke and gas to irritate the workers — just a steady, uniform heat that works from the inside out, making the rivet shank hotter than the head, with the minimum of scale, fewer spoiled rivets and *current consumed only when rivets are in the jaws.* No wonder this ingenious device has won such wide-spread recognition in such a short time.

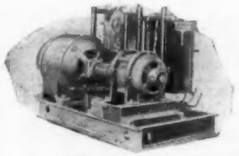
Performance of this kind is typical of the G-E electric heating equipment in a variety of industries. From the big electric ovens which bake the enamel on an automobile body with perfect results, down to the electric soldering iron which allows the man of the house to mend a leaky saucepan, the usefulness of electric heat is making itself felt in practically every place that heat is required.

The fact that electric heat is so simple to control, so accurate, so quick, and so safe under all conditions, makes it a vital necessity in some fields and a much desired improvement in others, regardless of its initial cost. This, together with the almost boundless resources of the General Electric Company in research as well as experience, insures the prospective user absolute reliability if he calls upon G-E to satisfy his heating requirements, large or small.

Self-regulating solder pot



Compound melting pot



Single operator arc welding set

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

19-39

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SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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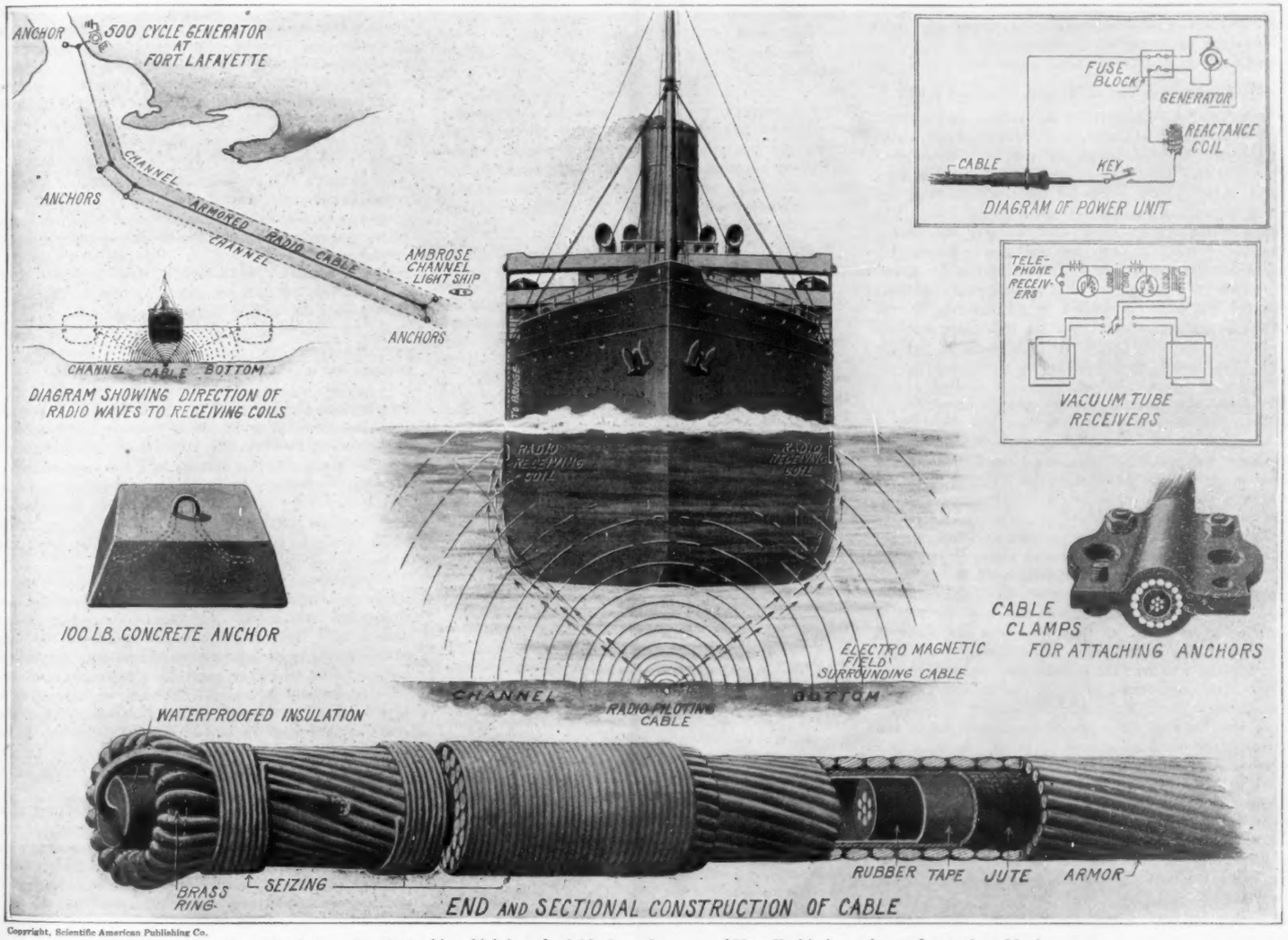

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Details of the radio pilot cable which is to be laid along the route of New York's incoming and outgoing shipping

New York's Radio Pilot Cable

By George Gaulois

MUCH has been written about the electric cables used during the war for the purpose of piloting ships in and out of harbors at night. Indeed, it now appears as though this system of navigation is one of the greatest benefits derived from the war, and one that is just as important in peacetime as in war. However, with the installation of such a system in New York Harbor by the United States Navy, it is now possible to give exact details of how the radio pilot cable operates.

In brief, the principle of the radio pilot cable, as it is called, is to employ a cable through which flows alternating current. Ships intending to use the cable while passing in or out of waterways are provided with a pair of coils which intercept the electromagnetic waves emanating from the cable. By noting the relative strength of the waves reaching each coil, it is possible for the ship's navigator to determine when he is astride the cable. Once riding astride the cable, it is relatively easy to follow it along and thus steer a correct course. In certain installations two cables are laid, each carrying a current of a given frequency. Ship navigators can tell which is the incoming and which is the outgoing cable by making careful note of the sound of the waves. In this manner a route is provided for ships going in either direction, and the chances of collision are reduced to a minimum.

In the New York Harbor installation, which will follow the Ambrose Channel, one type of cable has been specified. This cable consists of seven strands of No. 16 tinned copper wire insulated with a layer of 30 per cent Para rubber 3/16-inch thick, over which is wrapped a layer of tape and jute, impregnated with a water-proof insulating compound. Over this layer of jute is an armor which consists of a wrapping of No. 12 galvanized steel wire. The overall diameter of this cable is approximately one inch. Some 87,000 feet of cable will be required.

There will be two anchors secured to the extreme end of the cable and only one anchor will be used at each of the three other points along the cable.

A one-killowatt motor-generator will be used for supplying 500-cycle alternating current to the cable. The voltage may be either 125 or 250 volts. Provision will have to be made for driving this generator from local source of current supply so as to maintain the motor-generator set at a constant speed. It is obvious that a fluctuation in the speed of the generator results in a change of note, which is apt to cause much confusion when using the cable. The amount of current flowing in the cable will be under control at all times and will range from one to eight amperes. A telegraph key is to be installed for the purpose of

(Continued on page 210)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

To Preserve a Beautiful and Historic Work

THREE-QUARTERS of a century ago a great American engineer, J. B. Jervis, built across the Harlem River, as part of the original Croton Water Supply, a handsome masonry aqueduct which stands today as one of the few remaining fine examples of the engineering work of its time. The High Bridge viaduct was built to carry the Croton aqueduct across the deep gap near the northern limits of the city through which flows the Harlem River. It consists of a series of round arches supported upon massive piers, two of which stand squarely in the navigable channel of the river. In that early day, the traffic through the Harlem River was light; but the river piers have come to form a very material obstruction—so great, indeed, that the United States War Department has demanded their removal.

With the construction of the new aqueduct which passes beneath the river by a large syphon, the old aqueduct has ceased to have any immediate use; and various plans have been suggested to deal with the resulting situation. The city's Department of Plant and Structures advocated the complete removal of the bridge; but the Department of Water Supply urged that the bridge be preserved as an emergency reserve.

Now the aqueduct is historically valuable as being a fine example of the early work of American engineers. John B. Jervis, who built it, was the chief engineer of the Croton aqueduct at that time and his claim to recognition and remembrance is enhanced by the fact that it is he who was the constructive engineer of two other great engineering projects, the Erie Canal and the Hudson River Railroad. Artistically considered, the Croton Aqueduct has always been regarded as one of the ornamental structures of magnitude in a city which possesses all too few works of this character.

We are glad to know that the American Institute of Consulting Engineers has taken this matter in hand and that they have drawn up a plan which aims to combine the new and the old parts of the structure in a way that will preserve the harmonious beauty of the whole. It contemplates the removal of two of the piers and the replacing of the three arches by a single arch of a flattened, semi-circular outline, with a clear height equal to that of the other round arches and a clear span of 231 feet. The interior of the structure will be built of reinforced concrete; its exterior will be clothed with the dressed stone removed from the old arches and piers which are to be replaced. As a consequence of this the face of the finished structure will match the rest of the bridge in the weather-stained appearance of its masonry and will harmonize perfectly with the tone and color of the whole bridge. Furthermore, an illustration of the reconstructed bridge shows that this central arch of wide span will relieve the monotony due to the constant repetition in the old bridge of arches of equal or approximately equal span, and that it will add greatly to the dignity and general architectural fitness of the whole work.

This meritorious suggestion should command the hearty approval not only of the authorities but of every citizen of greater New York. For not only will it preserve to the city a reserve aqueduct which, in case of emergency, might prove to be of greatest value, but the engineers have found that they can widen the top roadway and utilize it as an additional automobile driveway between Manhattan and the Borough of the Bronx, at a point where for over a mile there is no street connection between the two sides of the river. In its plea for the perpetuation of this structure by changes which will add to rather than detract from its beauty, the committee reminds us that the design of the aqueduct places it in the same class as the famous Roman aqueducts, the remains of which are among the chief attractions of the old world.

"By Their Fruits Ye Shall Know Them"

WILL the day ever come when a discerning public will accord to the civil engineer the tribute of gratitude and perpetual remembrance which is surely his due when he conceives and puts through masterpieces of engineering construction? Is it not a reflection upon human nature that only in the rare cases when the engineer happens to be also the financier of a great undertaking, does posterity associate his name with his work? Too often the master mind which conceives a noble engineering project, solves its many problems as they develop, carries the burden of its multiplied anxieties, and transmutes his great dream into a splendid reality—too often he passes out of the public mind, and his name and fame are known only to the comparatively limited number who grace his own profession. Henceforth his masterpiece is associated with the name of the promoter and the financier, and to them accrue the rewards and financial profits.

A notable case in point is that of the distinguished engineer, J. B. Jervis, whose name, honored in the records of the civil engineering profession, is probably forgotten, if it were ever known, by the great world that for three-quarters of a century has enjoyed the benefits of his work. To think of the Erie Canal, of the Croton Water Supply, of the Hudson River Railroad, is to think of Governor Clinton and of that unique genius, Commodore Vanderbilt, not of Jervis. Mention of the Suez Canal brings to mind and always will De Lesseps; but De Lesseps was financier as well as engineer. The Panama Canal, to be sure, will be associated with the name of General Goethals, but he himself, doubtless, will tell you that, backed by the influence and wealth of the United States Government, he merely applied great organizing ability to the carrying out of a plan that was formulated and developed by men whose names have already, so far as the Canal is concerned, passed into obscurity. Foremost among great engineering works is our original New York subway system, the work of William Barclay Parsons; but, except for a commemorative plate in one of the least-used of the local stations, there is little to remind us how greatly we are indebted to this engineer for solving the problem of rapid transit at a time when the city was threatened with unparalleled congestion.

There are, of course, notable exceptions, prominent among which is the beautiful suspension bridge across the East River—to think of the Brooklyn Bridge is to think of Roebling. But among the millions who have crossed and will continue to cross the great Forth Bridge in Scotland, how many recall the fact that the construction of this majestic work was due to the fine vision and daring of Benjamin Baker. True it is that, following an admirable precedent, Baker was rewarded with a baronetcy, a practice which is common among the older civilizations. Our prejudices prohibit the granting of such rewards; but we cannot but feel that in some other way a means might be found to perpetuate in the minds of a so greatly enriched posterity the memory of the men who, in the routine of their honorable profession, have the imagination to conceive, the courage to suggest, and the ability to carry through works of the first magnitude.

The Scope of Common Law Trade-Marks

THERE are two features of American trade-mark law which are not adequately understood by the majority of trade-mark users. One of these is that trade-marks are not property in the sense that we ordinarily give the term. The right to use a trade-mark is something that can be established in this country only by its exercise; the source of the trade-mark right lies ultimately in the use of the mark, and not at all in the official document that certifies this use to be a matter of public record.

The second point to which we would advert is that trade-marks are not under the entire control of the Federal Government. Acting under the provisions of the Federal Constitution which delegate to that Government exclusive control over all matters affecting foreign and interstate commerce, Congress has passed certain acts applying to trade-marks. But trade-marks are as old as the common law. Small manufacturers, who to all intents and purposes restrict their business to the State in which they are located, may adopt trade-marks, and having by using these marks established their right to use them, may through the State courts protect these rights in the State.

But there are in the English language a limited number of words. It is certain that cases will arise in which identical or similar marks will be originated and used independently by different persons. Usually these marks will be used on entirely different articles But the long arm of coincidence knows no limits; small concerns doing similar local businesses in different parts of the country now and then hit upon the same word or other mark to identify their goods. This is all well enough so long as these businesses stay put in their original limits; but when one or both expand, there is the possibility of their coming in contact.

In practice this actually happens. John Jones, of some Connecticut town, the local apothecary and known to all his constituents by the affectionate diminutive, has a wonderful cure-all descended from his great-grandmother which he dispenses over his prescription counter. At length he puts it up in little packages and builds up a small business in the neighboring counties, having branded the article as Jack's Infallible Nostrum. The business eventually spills over the State line, and finally arrives in the northeastern corner of Ohio. There it strikes a snag.

It appears that some ten years after the mark Jack's was first applied to Mr. Jones medicament, or perhaps ten years before, a Cuyahoga County gentleman by the name of Jackson had invented a very successful cure for the distressing symptoms of the morning after. In recognition of the fact that his acquaintances found two syllables too much of a mouthful in pronouncing his name, he identified this to the local drug trade under the name of Dr. Jack's Miraculous Remedy; and it has had a considerable sale ever since.

It may seem that these are rather trivial and unsatisfactory grounds on which to base the selection of a trade-mark; but a vast majority of the marks in existence have their origin in some equally trivial fact or incident. As the case stands, there is no suggestion and no belief by either party that the other has consciously imitated his mark. Yet one or the other is sure to feel that his rights are invaded. Either the Jones remedy must be barred from Ohio, or the Jackson panacea must be subjected to competition in the established field of its sale by another article of a name similar enough to lead to confusion.

A case recently decided in the Supreme Court was along substantially these lines, the good faith of the two users of the same mark being mutually admitted. The Court laid down the principle that the date of original adoption by either party, and the particular territory in which they now meet, are of no moment. And it then enunciates the eminently sensible doctrine that if either of these "Jacks" had ever wished to protect his mark in interstate commerce, the Federal laws provided him with the opportunity to do so. That neither of them availed himself of this opportunity is evidence that each has been negligent in allowing certain inchoate rights to lapse. So the Connecticut Jack may sell under this mark in the territory where he was first established, and the Ohio Jack may do likewise. Each Jack retains all the rights in his mark which he has previously exercised and no more.

Every small business can profit by the tale thus anonymously and parabolically told. The very first sale in interstate commerce of any marked article can, and should, be made the ocasion of application for a Federal trade-mark. Then if there is any reason why such application cannot be granted this fact will become known in time to prevent the building up of any considerable business under a mark that is open to infringement; and if there is no such reason, permanent trade-mark protection is attained.

Gas Engine Versus Steam Engine

The Rôle Which the Motor Truck Can Play in Transportation, as Indicated by California's Experience

By H. A. Crafts

IS the gas engine destined to displace the locomotive? Is the auto-stage to take the place of the passenger coach? Is the auto-truck to supplant the freight car? These are questions that are agitating thinking minds.

These questions are of interest everywhere, but nowhere more so than in California, because California has so long been under the domination of the railroads. Nor is the subject merely speculative. The possible change seems to be on the way. And such inroads are the motor truck lines making upon the revenue of the railroads that the latter are up in arms about it.

One of the important civic institutions of California is the State Railroad Commission. This body has wide plenary power, and does things. It fixes rates to be charged by every common carrier whether it be a railroad or a line of motor trucks. It gives audience to all sides and carefully notes all important evidence. It has power to raise or lower tariffs, as its best judgment may dictate. One of its functions is to grant licenses and franchises for various kinds of transportation lines.

Just the other day the California State Railroad Commission was sitting in the city of Oakland. G. F. Nesson and A. C. Woodward had put in an application for a franchise for a motor truck line to run from Oakland to San Jose, fifty miles south. The railroad folks were there to oppose the granting of this franchise.

The feeling in railroad circles as to the motor truck lines was indicated by the strong language employed by Edward Entelman, assistant superintendent of the Railroad Administration, in his testimony before the board. He referred to the motor truck lines as "robbers of the highway," and charged that they were "not dependable." Then he went on to say:

"Profits that the Southern Pacific Railway Company are making on the line between Oakland and San Jose are very small. On the average the haul from San Jose amounts to only about three carloads per day."

Similar views were expressed by J. L. Allen, traveling agent for the American Railroad Express Company.

In rebuttal of this testimony W. J. Harris, wholesale produce merchant of Oakland, testified that the railroad service between Oakland and southern points was inadequate, particularly in the handling of perishable goods. Slowness of delivery on the part of the railroads was the chief complaint made by Harris. Produce from the South, he said, was not delivered early enough in the day to permit prompt distribution.

"If the produce is not at the store at 5 o'clock in the morning," said Mr. Harris, "the railroad may as well keep it until the next day. As a matter of fact the railroad company seldom makes deliveries before 8 o'clock in the morning." In consequence of this defective delivery on the part of the railroads, Mr. Harris further testified, the commission merchants of Oakland had been compelled to install their own truck lines. But it is not necessary to take the testimony of the railroad people nor of the motor truck men to get an idea of the expansion of the "ship-by-truck" business in California. That which we see every day on the city streets and country highways is sufficient to convince anyone of the revolution that is going on in transportation circles. The motor truck is in evidence everywhere.

From the country districts it is bringing in great loads of milk, butter, eggs, poultry, fruit, vegetables, hay, grain, and other farm products. Often the truck hauls a train of trailers, all heavily laden, yet whirling along the highway at a lively clip. The old-fashioned early milk train on many railroads has become almost obsolete, the big dairies having installed an efficient motor truck service on their own account. The poultry and egg people have followed suit, and with their trucks make four collections and as many deliveries in a day. Outward bound trucks laden with merchandise, household furniture, etc., are in equal evidence. Public motor-truck and auto-stage lines multiply daily and radiate from the larger centers in every direction.

In San Francisco there are 26 regularly organized motor-truck lines that run on regular schedule time. These lines cover routes all the way from five to two hundred miles in length, reaching such points as San Jose, Stockton and Sacramento. Oakland has a motor truck system of almost equal size. The auto-stage lines are also numerous, and their routes extend as far as Los Angeles.

These lines are establishing neat and comfortable passenger stations in the central part of the city. Their time-cards are all worked out to a nicety and occupy prominent places in public view. They appear to be doing a flourishing business, and are most attentive to the needs and comforts of their patrons.

The whole business presents an aspect of extreme democracy. A condition of cordial good fellowship seems to exist between agent and passenger, and between passengers themselves. The latter, in their departures, their arrivals, and their progress along the highway appear more like parties of joy riders than mere wayfarers. These lines make a point of having ample rolling stock and operatives on hand in order that all travel may be handled promptly, and on schedule time.

Both the auto-stage lines and the motor-truck lines appear to bringing the city people and the country people into closer relationship, socially as well as industrially. The two forces are not only revolutionizing established lines of communication, but are developing new fields, remote sections hitherto isolated from the world.

I have it upon the authority of leading automobile experts that there are today in California more than 900 towns and cities containing an aggregate population of 89,000, which are absolutely dependent upon highway transportation. These out-of-the-way places are being brought into closer touch with the centers of popula-

(Continued on page 210)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Taking the Guess Out of Photography

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 13th last, in the page devoted to "Inventions New and Interesting," I notice under the above heading that a New York press photographer has invented a novel way of focussing hand cameras by means of a telescope, the objective of which is of the same focal length as the lens used in the camera. I am afraid this photographer must content himself with the credit due to a re-inventor, as the device is over thirty years old.

In the "Optics of Photography and Photographic Lenses," by Mr. J. Traill Taylor, published in 1892, a whole chapter is devoted to this very method. The author discusses the question fully, first mentioning a demonstration of the arrangement in 1886, and then dealing with the inadequacy of ground glass screens: aerial images; the nature of the focussing telescope and its adjustment to the camera; the use of the system, and the adjustment of dissimilar lenses to effect any requisite correction of the telescope objective in respect of focal length.

The book could probably be seen in any technical public library, and the chapter in question (No. 29) appears in page 170 of the edition of the work published in London in 1892. Mr. Taylor's name is of course well known as a writer on photographic matters and as a former editor of various photographic papers, including, at some period, the *Photographic Times* of New York. "T. H. P."

Toronto, Ont.

Who Will Buy Dutch Factories?

To the Editor of the SCIENTIFIC AMERICAN:

At the moment there are for sale in Holland various works, factories and engines, whose present proprietors are without funds to continue their businesses. We are taking the liberty to bring this state of affairs to your attention, and hope that you may be able to give the matter publicity. We should think that American business men might profitably take advantage of the opportunity to buy these items, in view of the fact that the present exchange rates would enable them to buy at very favorable prices. In Germany, too, there would be wide opportunities of this sort, and here the difference in exchange would operate even more in your favor. We should be pleased to handle any inquiries covering this matter.

Arnhem, Netherlands. GEBR. OOSTERHUIS.

First Naval Electric Drive

To the Editor of the SCIENTIFIC AMERICAN:

May I venture to correct your naval contributor in a statement which appears on page 712 of the June 26th issue just to hand. He states that the U. S. S. "Jupiter" is the first naval vessel of any nation to be fitted with electric drive. If you look up reliable books of reference you will find that the German submarine salvage ship "Vulkan" was the first (1907).

FRANK C. BOWDEN,
London, Eng. Captain, Royal Marines, Retd.

Further Data on Mexican Oils

To the Editor of the SCIENTIFIC AMERICAN:

Your unexpectedly early publication of my article, "Our Future Oil Supply," forestalled me in certain corrections which have become in order since the original preparation of the manuscript, and which I had intended to ask you to make before you set this matter up. I should appreciate it if you would find space somewhere for them now.

American operations were carried on in the Mexican fields before the date, 1904, which I mentioned; but it was in that year that work was first attempted in earnest.

If I were writing today of the Juan Casiano well, I should have to employ the past tense and speak of its total output rather than its production to date. Just the other day this splendid producer suffered the fate which had already overtaken the Portrero del Llano, being drowned out by salt water.

In speaking of the third field of Mexican oil operations, that of the extreme south, I would like to make the point that in portions of this field, especially in Tabasco, shallow sands are encountered, principally at depths of 400, 800 and 1,200 feet, which are believed to have great possibilities and which have already shown excellent results. Oil seepages here have been known by the Indians for years and the fluid used for medicinal and other purposes.

A. HOOTON BLACKISTON.

The Life Gun On the Ship

To the Editor of the SCIENTIFIC AMERICAN:

I was very much interested in the letter that appeared in your issue dated June 19th, written by Capt. Edward G. Bancord regarding line-throwing gun, and wish to add a correction and a suggestion.

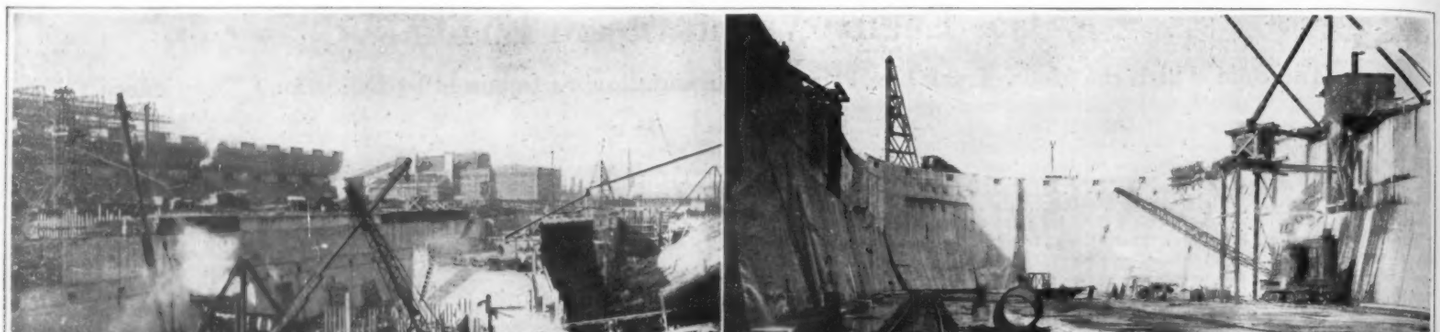
The Captain quotes the Steamboat Inspection rules as they were. These rules were amended on February 21, 1919, to read:

"All steam vessels of 150 ton gross or over navigating the ocean shall be equipped with at least three line-carrying projectiles and means of propelling them, of a type and character which have been officially approved by the Board of Supervising Inspectors."

Being the inventor of the gun illustrated on cover of your issue of January 31, 1919, and having given this particular subject much of my time and attention for the past two years, I feel that I am qualified to speak on the subject, and note that the Captain speaks only of getting a connection between a ship that is stranded and the shore for the purpose of rigging up a breeches buoy. Will he not agree with me (and every seafaring man that I have spoken to on the subject) that its usefulness extends far beyond aiding stranded vessels, especially in getting a hawser to a ship at sea that has broken down and sent out a call for help?

For every case where a vessel goes on to the beach, there are fifty breakdowns at sea in which instance the vessel loses her steering way and is wallowing in most instances in the trough of a heavy sea, making it impossible for the rescue ship to approach too near on either the windward or the leeward side without assuming too great a risk. Right here is where the line-throwing gun can be used to advantage in getting a hawser to (or from) the crippled vessel with which to get her head to sea, or for towing her into port.

New York. MAX RINDSKOPF.



Left: General view of the pump well *Right:* Bottom of the dock, looking toward the head

Scenes during the construction of the great Philadelphia drydock

A Neat Problem in Hydraulics

How the Delaware River Was Held at Bay During the Construction of the Naval Drydock at Philadelphia

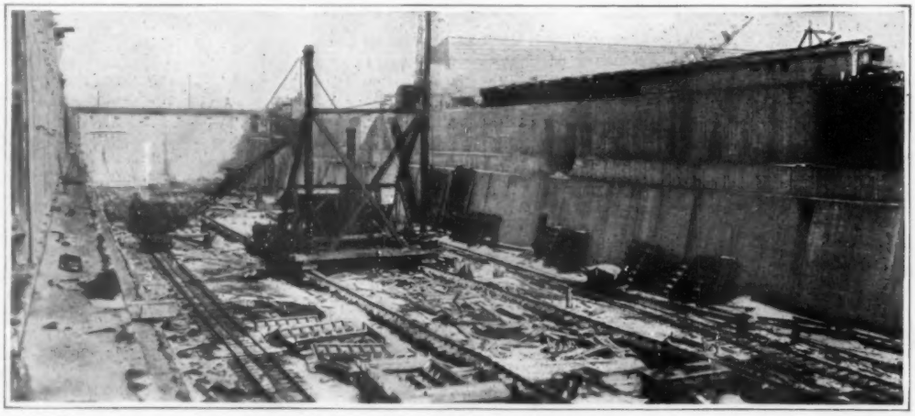
By J. F. Springer

IT is more or less notorious that engineering work involves unknown factors. On a big job it is frequently the case that no one knows what great problem lies ahead. Suddenly, the unforeseen or the unforeseenable happens. The thing that has taken place or the facts that have been discovered may affect the whole general plan and effect a revolution in the method of attack. Men are trying to eliminate uncertainties, trying to ascertain in advance precisely what conditions will have to be encountered at every stop. And a good deal of progress has been made along this line. It is now considered quite the thing to put down exploratory bore-holes over a site where some important work is to be located, the purpose being to find out precisely what the excavation and construction problems are going to be. A good deal of expense is thus incurred; but the money spent is well spent. But, do what he will, nature has so many and so various things at her disposal that she is still able to provide man with surprises.

The big dry dock now under construction for the United States Navy at the Philadelphia yard offers an illustration of the occurrence of the unexpected. A considerable number of bore-holes were put down. These revealed the character, thickness and relative position vertically of the strata covering the site. It was ascertained that a thick stratum of tough red clay covered the site at a level suited to provide a strong impervious footing upon which to construct the floor. The clay was encountered at about 52 feet below the water level. Above it was a comparatively thin stratum of fine hard white sand, which was overlaid by a stratum not much thicker, composed of cemented gravel. Next above was a thick stratum of graded sand. Finally, a great layer of river silt overlay this sand and all the strata beneath. A good deal of this was pretty well known beforehand, so that as these strata appeared during the actual excavation they probably occasioned no surprise. But what was *not* known was the serious results that would ensue upon excavating through the sand and gravel overlying the red clay.

It had been expected to construct a dry dock similar to the new one building at Portsmouth, Va. The side walls of the structure were to be cellular. Pretty much all the excavation was to be done by means of a suction dredge. That is, the dredge was to excavate over the site down to about the desired level, a cofferdam having been put across the entrance to the dock. An earthen cofferdam had been partially constructed and some 460,000 cubic yards of material had been taken out. In fact, the floor of the whole excavation had been pushed down to 27 or 30 feet below low water. What happened then was that, when the dredge operated, the banks would slide in as rapidly as the bottom could be cleared. No side slopes of a reasonable character could be maintained. So the dredge was removed. The cofferdam was now finished and the site unwatered. It was then seen that the cutter of the dredge after penetrating through the river silt had entered strata that were heavily water-bearing. The continued falling in of the banks had resulted from the great flow of water.

After the dredging operations had come to an end, new bore-holes were put down with a view of correcting and confirming the earlier holes. The later holes showed that the stratum of red clay was continuous over the site and that it had an average thickness of about 18 feet. Underneath the clay was found a layer of fine sand well compacted, whose thickness varied somewhat. The finer sand was succeeded by coarser. The holes were continued on down to about 75 or 80 feet below low water, when it was seen that there was enough pressure on the water entering them to cause it to flow freely out of the tubes forming the casing of the holes. The heads of the casing tubes were about the level of the floor of the excavation as left by the dredge. The holes, or some of them, were pushed down 5 feet farther, when the water actually spurted out of the casing heads. The pressure back of these jets was ascertained by means of pressure gages. It was found to be 10.5 pounds per square inch. Now a hydraulic head increases at the rate of 0.434 pounds per square inch per vertical foot. Dividing 10.5 by this number, one gets 24 feet for the effective head acting on the water. The actual head would probably be something greater, as some loss is to be taken into account. The result of the discovery that there was a 10.5-pound pressure on the water was the inference that the Delaware River itself was the source of the water. This meant that the sand under the clay connected pretty directly with the river bottom not far away. In view of this line of reasoning it became important to preserve intact the clay overlying this deep sand. It was necessary to make sure now before proceeding farther, that a sufficient depth of clay would be left over the deepest areas required in the excavation. Furthermore, it was determined to avoid opening up any very large areas at any one time. One vertical foot of clay would balance, by its weight alone, two feet or more of hydraulic head. The under surface of the dock was to be at such levels, however, that at places not a great deal of the clay would be left in place to produce its restraining effect. Nevertheless, by working cautiously at such locations and by putting the concrete in at once the danger could be minimized. This was, accordingly, the general plan.



A general view of the finished job, looking northeast

In order that the excavation might be properly carried down to the full depths required, and these extended to fairly low levels in certain parts of the bottom, steel sheet piling was driven to form a cofferdam all round the bottom excavation. The steel sheeting was driven well into the red clay. The length of the piles varied from 26 to 44 feet, depending upon the depth of the excavation required nearby. The side walls of the steel cofferdam were some 162 feet apart. The wall of sheeting completely enveloped the head end. It was thought desirable, too, to run transverse

(*Continued on page 210*)

How a State May Grow a Timber Supply

By George H. Dacy

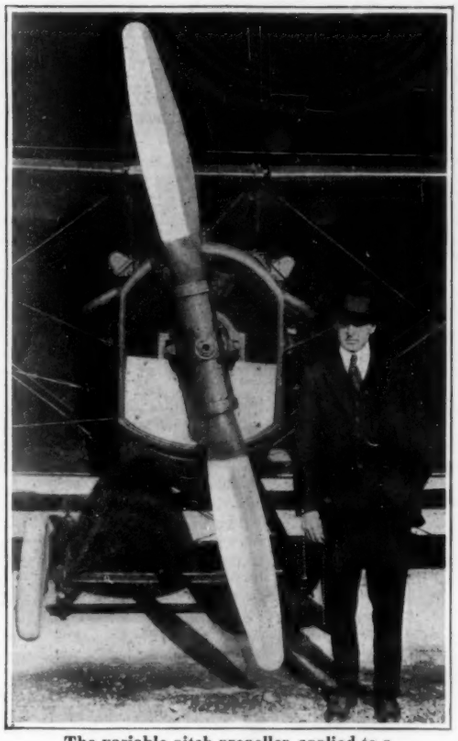
WITH all kinds of lumber in demand at higher prices than ever previously have obtained for building material of this description, the commercial possibilities of planting productive forests for potential utilization are beginning to appeal more attractively to those who, heretofore, have displayed liftle interest in reforestation projects. The most unique legislation now pending anywhere in the country in this regard is, at present, on the official gridiron at Springfield, Massachusetts. The lumbering resources of Massachusetts are rapidly being exhausted and official statements are to the effect that within the next score of years the State will have to import all the lumber it annually consumes from the Pacific Northwest. Such importations naturally will entail huge expenditures for freightage from the mills where the logs are sawed.

The business, lumbering and industrial interests of Massachusetts got together for a portentous pow-wow over the lumber situation. The result of this meeting was the submittal to the State Legislature of a practical and profitable plan for remedying the potential timber crisis in that State. It was ascertained definitely that there were about 1,000,000 acres of rough and scrub growth land suitable only for reforestation—so far as profitable production was concerned. The bill ultimately drafted proposed that the State purchase 250,000 acres of this land which could be bought for $5 an acre and seed down the entire tract to white pine trees. This work of planting would cost about $15 an acre while the maintenance charges including taxes would aggregate 70 cents an acre annually.

The bill proposes that the State issue and sell bonds to finance the project. It takes about 50 years for pine trees to reach maturity so that the bonds would be issued for that period. At the end of a half century, the value of the land per acre with the interest at four per cent compounded semi-annually would be $368.91. According to expert lumbermen, white pine of this character would yield about 30,000 feet of lumber an acre so that the stumpage value of the lumber at the end of 50 years would be approximately $600 estimating the pine at $20 a thousand feet on the stump, which is a conservative figure.

Thirty-one thousand voters have recently petitioned the Massachusetts State Legislature to pass this bill and at present are working to have a special election called to decide upon the issuance of the bonds. The consensus of opinion is that this project would be a good business venture for the State to embark in while it also would influence to keep the boys on the farms in the regions where the State forests were laid out. Under existent conditions, farm work is slack in the section under discussion during the winter months so that the farm boys have to go to towns and cities to secure jobs. The State forests would alleviate this condition as they would provide plenty of work for men and teams during the winter season when the pressure of farm work was lowest.

A State system of forests such as is outlined in this article would ultimately develop a permanent supplementary lumbering industry which would justify the year-around operations of the sawmills and the construction of small and permanent towns for the lumbermen and their families. And in addition to providing plenty of permanent work for the logging crews it also would occupy the idle labor of the adjacent farms throughout the year in such work as laying roads and trails, thinning the trees, patroling and protecting the forests against fire outbreaks. The permanent establishment of a large scale lumbering industry will develop a home market for all the surplus farm produce which the farmers desire to sell.



The variable pitch propeller applied to a standard airplane

Varying the Airplane Propeller Pitch

By M. A. Henry

AT last the airplane has been fitted with "three speeds foreward and reverse." Government tests of the Hart variable pitch propeller recently made at McCook Field, Dayton, indicate that this device will accomplish for aircraft exactly what a gear set does for the automobile, greatly improving the efficiency of the machine.

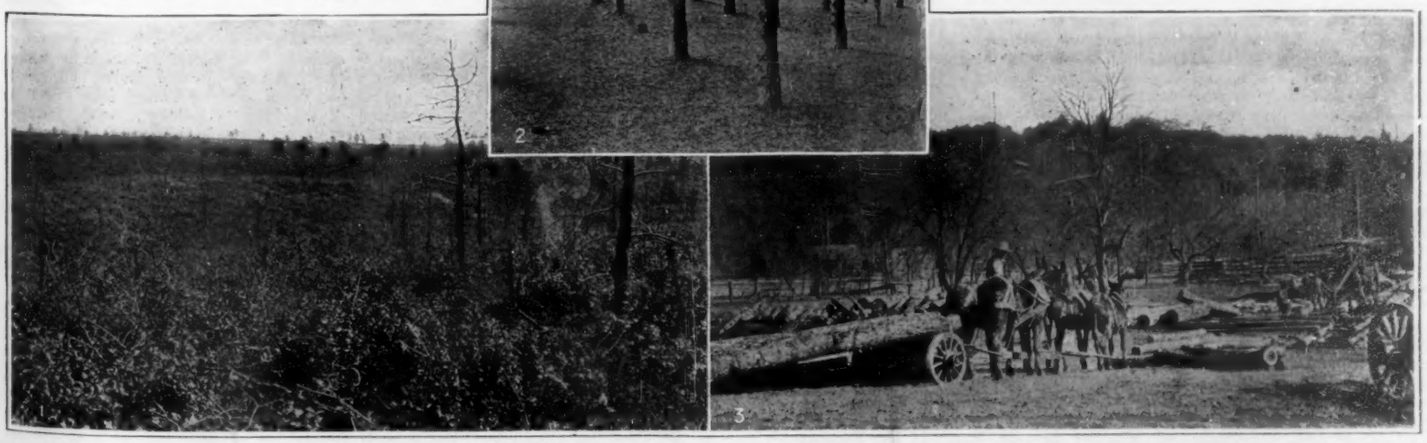
The new propeller permits the pilot to adjust the angle or pitch of the propeller while in flight by the simple movement of a lever. This permits maximum efficiency from both propeller and engine under all conditions, a thing heretofore impossible.

Thus in high altitudes, where the air is thin, the pitch is increased. This prevents the "racing" of propeller and engine. In long cruises, too, the propeller angle is increased and the motor throttled down. This effects a great saving in fuel and saves engine wear. In "taking off" a very narrow angle is used and it has been found that the machine can get off the ground quicker. Equipped with a variable pitch propeller a machine can climb faster and higher. In landing the pitch of the propeller is actually reversed and it becomes a brake, stopping the machine very quickly, once it touches the ground.

While the device was developed for military purposes, it is expected to be a big factor in commercial aviation, since it effects large savings in operating expense. The inventor is Seth Hart of Los Angeles, who brought his invention to McCook Field after some encouraging preliminary tests in the West which were described at the time in these columns. Word comes from France to the effect that excellent results have been obtained with airplanes fitted with variable pitch propellers. It appears that this idea is steadily gaining ground and must soon become a regular feature of aviation.

Joseph Norman Lockyer, K. C. B.

THE cable announces the death in London, on the 16th inst., of Sir Norman Lockyer, one of the more prominent British astronomers. Sir Norman is a conspicuous instance of the amateur graduating into professionalism, having been in the first instance a clerk in the War Office, devoting his leisure to astronomical pursuits for which an education pursued at British and Continental universities amply qualified him. After a more or less unofficial commission under the auspices of the Duke of Devonshire, he was finally transferred, in 1875, after eighteen years of service at the War Office, to the Science and Art Department at South Kensington. Upon the foundation of the Royal College of Science he became director of the solar physics observatory and professor of astronomical physics. His greatest activity has always been in connection with solar eclipses, eight of the big British expeditions for the observation of these having been conducted by him between 1870 and 1905. In addition he has to his credit successful work in the spectroscopic observation of sunspots and the radial velocities of the gaseous prominences; and for many years he has been one of the leading investigators of the chemistry of the sun. In the latter connection he is the author of several books, both explanatory and speculative. Professor Lockyer passed his eighty-fourth birthday in May, and had naturally, of late years, permitted himself an increasing measure of retirement from active professional duties.



1. Land of this description worth $5.00 an acre and valuable only for lumbering is the kind Massachusetts aspires to purchase. 2. A white pine plantation 22 years old produced on barren sandy land which otherwise would be non-productive. 3. Such a State lumbering project would provide much work for farm labor and teams at periods of slack farm work

Some pictorial aspects of the Massachusetts scheme for reforesting the barren lands of the Bay State

What Has Been Said About Einstein

A Review of the More Important Popular and Semi-Popular Books and Articles in English

By the Einstein Prize Essay Editor

NUMEROUS prospective competitors for the five-thousand-dollar prize have written us, asking more or less baldly where they may inform themselves upon the subject of the Einstein theories. We have no serious expectations that Mr. Higgins' money is going to be won by anybody whose knowledge of and interest in the doctrines of relativity is of such recent growth that he has to ask this question. Nevertheless, the thing is possible; and since we have no desire to exclude anybody from the competition, the query as to sources is one that must be answered.

At the same time it may be helpful to some of the better informed among the competitors to have their own judgment of the leading discussions supplemented by that of another. And, too, the average intelligent reader—who will look forward to the winning essay and its close rivals to give him an understanding which he has not yet got of the Einstein business—will probably be more than willing to have his way paved toward profitable reading of these essays. So it seems in order from every viewpoint to say a few words here in review of the best of the books and articles which have appeared in English on the subject.

The first book which we shall mention is that of Dr. Eddington. Before reading this we knew that the author was entitled to rank as the leading authority on the subject, probably among English-speaking people and certainly in Great Britain. After we had read it, we knew why. His book bears the imprint of the Cambridge University Press; it bears the title, "Space Time and Gravitation"—just like that. We do not know whether the mark that is missing between the words "Space" and "Time" exists in the author's mind as a comma or a hyphen; either would of course be entirely appropriate. But no doubts regarding the punctuation of the title can cast the least question upon the outstanding merit of the book.

Compared with other volumes upon the subject which have been presented for popular or semi-popular consumption, Dr. Eddington's is fairly large. Compared with some of the strictly mathematical discussions of relativity which have appeared in other languages rather more freely than in English, it is not so imposing. And in fact, on examination it falls on the same middle ground which this casual inspection of its bulk might indicate. It is not for the advanced student of relativity, nor is it for the person who is entirely ignorant of the modern mathematics. Nevertheless, it will be read with appreciation by a very wide and varied audience.

We may, however, without contradiction, qualify this statement to the extent of making it plain that the book will be read in its entirety with complete understanding by few persons indeed. There are parts which assume more than a rudimentary knowledge of differential equations, to which many very competent students of mathematics never attain; and there are parts that call for no mathematical training at all. The larger part of the book lies between these extremes, and will be intelligible to anybody who knows what coordinate systems and equations of transformation are, and who is willing to adopt a few new terms and assimilate a few new ideas as he goes. At the same time there are parts that call for a great deal more facility in handling the concepts of experimental and theoretical physics than either the layman or the mathematician can reasonably be expected to possess; and there are other passages that demand a fluency in the methods of thought peculiar to abstract philosophy greater than we should expect to find in layman, mathematician or physicist. Then there are places where a physicist, a mathematician, or a philosopher would be thoroughly at home in the subject matter, but would probably take exception to the distance which the author has gone in the direction of humanizing his treatment. In a word, the book is written by a man who seems to constitute a rather remarkable combination of mathematician, physicist, philosopher, and plain human being; and only a reader who himself approaches such a combination will get through it without encountering some serious difficulty. The reviewer, for instance, tries to be a mathematician and a human being, but freely admits that as a physicist he scores an absolute zero, and that as a philosopher he is on a level little if any higher than this. But few indeed who possess any inclination to attack the book at all will not be able to read large portions of it with great pleasure and extreme profit.

For the man who has a good general knowledge of what relativity is about and how it operates, this is the book of all books to act as a clarifier of mental processes. We found no alarming quantity of material in it that was absolutely new to us; yet we felt after completing the book that our grasp of the subject had been largely improved. Dr. Eddington has a knack of exposing and illuminating obscure points of whose very existence one had not been explicitly aware; of bringing out with great force the inter-bearings of the various aspects of the subject; of interpreting in terms of the perceptual world about us the abstractions of the mathematical theory. Anybody who believes himself capable in his present condition of writing effectively upon relativity should be able to write more effectively after digesting what Dr. Eddington has to say.

We must not pass from this volume without quoting from the preface a passage which embodies admirably the spirit of the whole book. "By his theory of relativity," we are told, "Albert Einstein has provoked a revolution of thought in physical science. The achievement consists essentially in this: Einstein has succeeded in separating far more completely than hitherto the share of the observer and the share of external nature in the things we see happen. The perception of an object by an observer depends on his own situation and circumstances; for example, distance will make it appear smaller and dimmer. We make allowance for this almost unconsciously in interpreting what we see. But it now appears that the allowance made for the *motion* of the observer has hitherto been too crude—a fact overlooked because in practice all observers share nearly the same motion [when compared to the extreme of possible motion, which turns out to be the 186,000-mile-per-second velocity of light]. Physical space and time are found to be closely bound up with this motion of the observer; and only an amorphous combination of the two is left inherent in the external world [when we have isolated that external world from everything that inheres in the observer]. When space and time are relegated to their proper source—the observer—the world of nature which remains appears strangely unfamiliar; but it is in reality simplified, and the underlying unity of the principal phenomena is now clearly revealed. . . . It is my aim to give an account of this without introducing anything very technical in the way of mathematics, physics, or philosophy. The new view of space and time, so opposed to our habits of thought, must in any case demand unusual mental exercise. The results appear strange; and the incongruity is not without its humorous side. . . ." This is altogether the best passage we have seen anywhere in discussion of the new theories; and the viewpoint here laid down is carried with extreme clarity throughout the book.

If Dr. Eddington's book is the work par excellence for the serious student of relativity in search of an outline for his guidance and inspiration, Dr. Slosson's Easy Lessons in Einstein (New York) occupies almost an equally paramount position with reference to the wants of the person who admits before he starts that he doesn't know anything about the subject and doesn't want to pursue it too deeply. It is the misfortune alike of the relativity theory and of the world that this theory is not easily clothed in terms with which we are familiar. Indeed, it is still an open question whether it is yet possible so to clothe it fully. The above quotation from Dr. Eddington should make it clear why this is so. Einstein shows us that the external world as we have always seen it is an elaborate interweaving of that world as it actually is and as it has been conceived to be through our imperfect observations and the imperfect conclusions to which they have led us. A better example of just what this means and how it works has perhaps not been given than the one set forth by the present writer in an editorial in these columns under date of December 20th last. The ancients, it was here pointed out, in default of any knowledge of how gravity acts in other locations than at the earth's surface, or of the insignificant position which the earth really holds in the cosmic mechanism, or of the true shape of the globe on which we live, must have supposed "up" and "down" to be directions inherent in nature, universally the same. Eventually, with the realization that down was merely the direction toward the center of the body on which the *observer* happened to be located, the concepts "up" and "down" lost any universal significance which they might have been supposed to have; the part which they play in the external world about us was shown to inhere in the observer, rather than in that world itself. It was doubtless with some difficulty that the public at large, in ancient and medieval times, grew into ultimate understanding of this. It is with still more difficulty that we shall come to the parallel but more elusive understanding that the distinction always heretofore made between time and space, and the notion that time runs on forever in a straight line divorced from all dependence upon space, are likewise the contribution of the observer to the world of perception; that the facts inherent in the external world and independent of the observer are quite different.

The very circumstance that all this is so means that when Einstein effects his further separation between the observer's conception and the external fact, what he finds still inherent in the outside world is something new and strange, of which we have no mental picture immediately ready, for which we have no words and even no accurate analogies. This does not trouble the mathematician greatly, because he puts it all into a differential equation, and says that this equation characterizes the space-time which he has just found to be the true one of the external world, whereas a different equation characterizes a space-time of the sort we have had in our minds for the past few thousand years. Strange and incredible as it may seem to the non-mathematician, these differential equations, which on account of the uncouth symbols that appear in them he cannot even read, actually possess meaning to the mathematician and to him seem a sufficient expression and interpretation of what he is talking about. But the layman has got to get a whole new stock of ideas and perhaps even of words in which to clothe these before he can make much of the new doctrine.

Dr. Slosson presents a wealth of material in which such of the old familiar ideas and the old familiar words as come closest to portraying the new concepts are displayed with considerable skill. He exhibits a particularly happy inspiration in pointing out that the doctrines of relativity, in so far as they involve the recognition of a four-dimensional manifold of time and space combined, are not nearly so terrible as the mathematical jargon in which they are couched would make it seem. In a very definite sense, once we realize just what is meant by the term four-dimensional, this manifold is nothing new at all—"unless we are idiots we all think that way" and always have. It is merely the explicit recognition of this, and some of the details that such recognition carries with it, that are

(Continued on page 212)

IN spite of several very candid opinions which have been expressed to the contrary, we cling to the belief that the Einstein competition is going to produce results that will stamp it as distinctly worth while. This, of course, implies that we expect some of the competing essays to surpass in actual subject matter and in the clarity with which this is set forth, anything that has yet appeared of comparable character in English. But this involves a comparison with what has appeared; and equally that this comparison may be made by others as well as by ourselves, and for the several other reasons mentioned in the text, we are moved to present this brief statement of what we have found best in the popular expositions of the Einstein theories. The list of books and articles which we find sufficiently good to mention here by title is indeed deplorably brief, and seems to show the inherent soundness of the donor's belief that there was room for further achievement in this direction.—THE EDITOR.

The Airplane in Mine Rescue Work

TO the constantly expanding uses to which the airplane is being adapted—patrolling forest fires, making timber and crop surveys, conveying census blanks in isolated regions, detecting the boll-weevil infested areas in Southern cotton fields, and eliminating distance between the doctor and his patient—is to be added another experimental effort. The assignment of airplanes as rescue workers in mine disasters is the hitherto untried development to be given practical application.

Negotiations are under way between officials of the United States Bureau of Mines and the Aircraft Service of the Army whereby airplanes will be given trial assignments in the mines of Illinois and Indiana. According to preliminary arrangements, in the event of a mine disaster, a plane from the nearest air-service station would be detailed to the headquarters of the district engineer of the Bureau of Mines. Here the air-going machine would be equipped with eight 40-pound oxygen tanks and dispatched promptly to the scene of impending trouble. Geophones, and a rescue car with its trained crew, could likewise be transported by the air route.

The United States officials have pledged co-operation when certain stipulations have been observed by the Bureau of Mines: Provide landing fields, with dimensions of at least 1,800 feet square, at each end of the journey; supply gas and oil at both terminals; and furnish the aviators maps of the route to be traversed. The equipment of desirable landing fields in much of the mining districts seems to be the difficult undertaking—not easy to be complied with in not easily accessible mining regions.—*S. R. Winters.*

Thicker Aerofoils

A REPORT upon the aerodynamic properties of thick aerofoils suitable for internal bracing deals with the results of a series of tests conducted at the Massachusetts Institute of Technology wind tunnel, with a view to developing aerofoil sections thick enough to permit of internal bracing and the use of cantilever wings without any external bracing of the airplane wing truss. The sections tested were based on the Durand 13, and were varied in section form, in thickness along the span, and in chord along the span. Tapering both in thickness and in chord was found to be highly beneficial to efficiency, and some of the wings developed gave L-D ratios practically as high at angles corresponding to very high speeds of flight as the best of the wing sections for normal type, together with very much higher maximum lift co-efficients. In particular, it was found that the substitution of a thick tapered wing for R. A. F. 6 on a 3600-pound fighting biplane with Liberty engine would increase the maximum speed by 18 miles per hour, due to the saving in parasite resistance by entire elimination of the interplane bracing. A copy of this report may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C.

Silver Fox Farms in Japan from Canadian Stock

ONE of the strangest and most interesting wild animal shipments left Vancouver, Canada on the steamship "Empress of Asia" the last week in February. The shipment consisted of six silver foxes from one of the largest fox farms in Prince Edward Island, eastern Canada, and was bound for Japan, where a syndicate is about to undertake fur farming. The foxes were valued at $5,000 per head, and were from a long line of domesticated stock, carrying a pedigree as notable as any famous horse or dog. The Japanese spirit of enterprise and their alertness to try any western form of business which promises good returns is most strikingly evidenced in their attempting to raise this producer of expensive fur in their own land. The climate of some parts of Japan, the representative of the syndicate claims, is sufficiently like the natural one of the Canadian foxes as to make the venture feasible. The animals while en route dined on chicken, choice raw beef, lamb and pork.—*By Francis Dickie.*

British Tidal-Power Plans

IT is understood that a bill will be introduced into Parliament for the purpose of obtaining authority for harnessing a number of Scottish streams, investigations having revealed that the aggregate of available power is larger than had been anticipated.

With respect to the harnessing of the tides, it is reported that "work is about to begin both on the Dee and the Severn, where power can be produced—according to estimates of a group of engineers—at two-thirds the cost of electric power generated by coal. More than this, a number of estuaries on the west coast of England have been surveyed, where the cost of installation would be considerably lower."

The basic principle underlying most of the inventions for harnessing the tides is the working of a turbine by tidal ebb and flow. The tide makes the power at both its inflow and its outflow, only ceasing for a comparatively short time during the period of half tide. In one Cheshire and Lancashire district the great variation in the hour of the tide at neighboring estuaries makes possible, through an ingenious discovery, the production of maximum energy during an almost continuous period.

The plan for harnessing the tides devised by Lewis Woodhead, of Worcestershire, calls for the building of a cheap and efficient wall out in the sea or tidal river, in which turbines are placed. Mr. Woodhead claims that 10-foot turbines would be most economical where suitable, each of which would generate over 300 horsepower with a 5-foot head. Thus a mile of sea wall would be capable of generating 120,000 horse-power. The position of such a wall would be 4 to 6 miles from shore. The greatest difficulty, he stated, that has to be overcome is the possibility of obtaining a space 110 by 30 feet on the sea bed dry, but he claims to have discovered a method of insuring this, so that the wall can be well anchored in the sea bed.

Glycerine

THE diversified uses to which glycerine is put indicate its importance in commerce. Most of the distilled glycerine finds its way into the manufacture of explosives, such as nitroglycerine, dynamite, and the more recently developed high explosives. These are generally a combination of nitroglycerine with guncotton or nitrocellulose, and the resulting product is known by a great variety of names. Commercially pure glycerine is a well-known reagent in pharmacy and medicine, where nitroglycerine itself is sometimes employed. Glycerine enters into a number of technical processes, such as the manufacture of soaps, inks, water-proof paper, and for the production of such plastic masses as printing rollers and other masses used in the art of reproduction. Glycerine is also used in gas meters and tubes which must withstand great cold, and for filling hydraulic jacks. It is one of the important items in sizing textiles and in that treatment of wine, beer, and vinegar known as "scheelizing."

Disinfecting Barrels and Casks with Ultra-Violet Light

ULTRA-violet rays have long been employed for sterilizing drinking water, milk, and other liquids, but a new application of them in Germany reported in *Chemische Apparatur* (Leipzig) is for the disinfection of barrels and casks, particularly beer casks. For this purpose quartz lamps are lowered into the cask to be sterilized and the light turned on for fifteen to thirty seconds. It has been found inadvisable to continue the illumination for a longer time in ordinary casks coated with pitch, since the resultant rise of temperature causes the formation of fumes of pitch. The lamps vary in size according to the dimensions of the casks. In small and average size casks the time mentioned is sufficient to secure complete sterility. Some difficulty is met with in using this method for very large pitch-coated barrels, even when there is a corresponding increase of size in the quartz lamp and a suitable tension, for the reason that so long an illumination is required that the aforesaid fumes are produced. The method is not to be advised therefore except for barrels which are not coated with pitch.

An Apple-Shipper's Makeshift

SHORTAGE of refrigerator cars has stimulated apple shippers of the Northwest to interesting makeshifts. In one recent season, a considerable portion of the British Columbia apple crop went to market in box cars equipped with stoves and stove-pipes. The shippers supplied men to care for the apples in transit, keeping the cars heated, and the apples arrived at destination in good condition.

A Chelan Falls, Wash., fruit shipper was confronted with a somewhat different problem this spring when he had 26,000 boxes of apples to market, and couldn't obtain refrigerator cars. He could not tell what kind of weather the apples would encounter en route to Cleveland, Ohio, where he planned to market them, but average seasonal weather would involve danger from heat rather than from cold, and he made his plans on that basis.

He obtained box cars and had a false floor placed in each. Beneath this false floor was sawdust, soaked with water to provide the apples with moisture. He accompanied the train of 28 cars, and saw to it that each night the car doors were opened to allow the apples to cool off.

Happily, no unfavorable vicissitudes of weather were met with. In Montana, the temperature got down around 25 degrees and froze the water in the sawdust. This tended to keep the apples cool throughout the remainder of the trip.

The train went through to Cleveland in nine days, much less than the usual running time. When the apples were unpacked, they were found in excellent condition. On the average, for the season, the makeshift was well calculated to be successful, but the shipper admits that a bad cold wave would have been serious. He had to take a risk somewhere.

The New Floral Clock

SINCE Linnaeus worked out his floral clock the list of available subjects has been very much increased. This is due to the introduction of fresh kinds of plants and also owing to the fact that new varieties of the old ones frequently show a variation in the time of opening their blooms.

The chief difficulty in putting together the list of subjects for the floral clock has been that they must all flower at the same time of the year, preferably in the summer months of June and July. Also the twelve species selected must expand their blossoms in successive hours from six in the morning to five in the evening. After a large amount of experimenting the following selection of plants has been put together and this is claimed to be the most perfect list for the floral clock up to date. Slight variations in the times of opening might occur in different localities, but it is remarkable how closely the various plants adhere to the times of opening. The times of the expanding of the buds are in all cases put before the name of the plant: 6 a.m., Yellow Hawkweed (Hieracium aurantiaca); 7 a.m., Marigold (Calendula pluvialis); 8 a.m., Venus' Looking Glass (Specularia speculum); 9 a.m., Corn Marigold (Calendula arvensis); 10 a.m. Clovewort; 11 a.m., Mountain Dandelion (Taraxacum montanum); 12 a.m., Fig Marigold (Mesembryanthemum); 1 p.m., Single Pinks (Dianthus); 2 p.m., Pyrethrum corymbosum; 3 p.m., Red Hawkweed; 4 p.m., Lady of the Night (Mirabilis dichotoma); 5 p.m., Catchfly (Silene noctiflora).—By *S. Leonard Bartin.*

Air Conditioning

IT is only lately that the proper conditioning of air has been recognized as a subject of fundamental importance in many industries. The possibilities of overcoming unhealthful air conditions are of course extensive and a secondary consideration is the aid to manufacturing processes which satisfactory atmospheric conditions give.

In the production of gelatine products, low temperatures and constant low moisture conditions must be maintained. In confectionery establishments cool, dry air becomes a requirement. In the baking industry a high humidity with proper temperature maintained constant, eliminates important variables in the raising of dough and enables the baker to standardize time. In the photographic industry the proper conditioning of air has been practised for some time, for otherwise there would be many days too hot or too damp for the production of satisfactory material. Even the printing art requires the conditioning of air, where several colors are used in the production of illustrations, for the perfect registration necessary for success cannot be expected under greatly varying atmospheric conditions. The silk industry has practised conditioning for a long time, but we have not yet been able to extend this work into the wool and cotton field. In modern textile mills, however, apparatus is being installed by means of which the condition of the air can be satisfactorily controlled.

A New Cyanide

THE development of a process for obtaining cyanide from cyanamid was recently reported before the New York Section of the American Electrochemical Society. It marks another accomplishment in the field of American electro-chemistry. The work has progressed rapidly, and the statement is made that in a few months more was accomplished than had been achieved abroad in fifteen years. Three months after starting designs for the plant, four tons of equivalent sodium cyanide were being produced each day, the grade being unusually high. Within a year a single small electric furnace of the continuous type was producing a very satisfactory cyanide at an unusually high efficiency.

The product is said to be uniform in quality, to possess desirable physical characteristics, and to be competing with the pure high-grade cyanides for markets where the latter has long been intrenched. The material is adapted for case-hardening, may be employed in the electro-plating industry, in connection with precious metals, and the preparation of pigments and prussic acid.

Fire Without Firemen

How the Coal Is Fed Mechanically to the Huge Grates Beneath the Modern Boiler

By H. A. Mount

WE are all worshippers of the colossal. The biggest steamship, the tallest building, the longest bridge never fail to interest. And in our admiration of big things we ofttimes forget the little things which make them possible.

Imagine, for instance, ye who have fumed over the family furnace on a cold day trying to fire by hand, one of the great modern steam boilers, with a fire grate 27 feet wide, that consumes more than six tons of coal every hour!

We hear very little of the mechanical stoker and yet it is one of the biggest "little" things of modern industry. Without it our whole scheme of power generation would have to be revised. The mechanical stoker was originated, not so long ago, to replace the grimy workman, whose sweat-gleaming torso, lighted by the furnace glare as he heaved shovelful after shovelful of coal, furnished one of the oftenest-pictured features of industry. But today the mechanical stoker finds a much wider usefulness.

Boilers which a few years ago were hand-fired are machine-stoked today with an increased efficiency of from 25 to 50 per cent. The amount of power used in this country has been increasing in recent years at a terrific rate. The mechanical stoker has made it possible to meet this increase, not by multiplying the number of boiler units, but by increasing their size.

The capacity of a boiler obviously depends directly on the amount of coal that can be burned under it. This in turn is governed by two factors; the area of the grates and the amount of coal which can be burned per hour on each square foot of grate surface. Mechanical stokers make possible the use of huge grates which would be impossible to fire by hand, and at the same time allow the coal to be burned with maximum efficiency.

Undoubtedly, had the mechanical stoker not been invented, we would have seen fuel oil and gas used to a much greater extent than at present. The stoker gives the same even, continuous fire with a low grade of coal, as can be had with either of these fuels, which cost approximately three times as much to burn.

There are available a number of types of automatic stokers, each of which has its sponsors. Two of these will be described here and they are representative, in a general way, of the whole field.

The simplest of these, and the type most generally used, consists of a fuel magazine or retort inside the furnace, to which leads a conveyor pipe. In the conveyor pipe is a screw or worm conveyor which constantly pushes a supply of fuel into the bottom of the pot. The fuel is ignited on top and the fire bed is formed on the upper edge of this magazine. The rising fuel from below causes the fire to overflow from the retort to sloping grates on each side.

As the coal moves upward through the fire-box and approaches the fire it is slowly roasted and coked. The released gases, mingled with a controlled supply of fresh air, ignite and burn as they pass through the blazing bed of coke above. The coal is delivered to the grates as coke and the continuous feeding gives a breathing motion to the coke bed, keeping it open and free for the circulation of draft. The coal is fed into a hopper on the outside of the furnace, either by hand or by machinery.

One of the prime essentials of the device is a method of producing a forced draught through the fuel bed, which can be closely controlled. The air is furnished by a blower or fan, operated by steam from the boiler or by electricity. The air is conducted to a wind box located beneath the retort and is distributed through tuyeres communicating with it. The distribution of air is regulated by a wind gate at the mouth of the wind chamber. The tuyeres are the only parts subject to destruction by heat and these are detachable so they can be quickly and cheaply replaced.

Due to complete combustion through the coking process, low grade coal can be used. The fact that it is seldom necessary to open the fire doors while the stoker is in operation effects another saving, estimated in some plants as high as 20 per cent. Ordinarily the fire doors may be kept closed for periods from six to eight hours. The largest saving, however, is due to the air control.

When it is considered that about fifteen pounds of air are required to burn one pound of coal, and that of this four-fifths is inert nitrogen which must be raised to furnace temperature but which does no work, the importance of using only the precise amount of air needed is realized.

The stoker forces the coal upward and into the fire and over the tuyeres. The tuyeres discharge the air into the coal at the points where the gases are liberated during the coking process. The gases ignite and pass off through the incandescent coal bed without smoke. The air is introduced under pressure to enable it to penetrate the coal bed where it is thickest, where it requires the most air and where there is the most resistence to a natural draft.

The forced draft equipment is a very important part of an underfeed stoker. A sufficient volume of air must be forced through the fires to burn the maximum amount of coal intended, and this naturally depends on the size and design of the ducts and the amount and kind of coal which it is proposed to burn.

A variation of the type of stoker just described injects the coal into the retort by a reciprocating plunger, which is actuated by a steam-driven piston in front of the boiler. The plunger has mounted on it several pushers which carry the fuel along with them on a forward movement, but slide through the coal in the reverse direction. This type of stoker also is usually equipped with grates with moving fire bars. As the coal rises in the retort it is distributed to the sides of the grate by the moving bars. Every other bar in the grate is made movable by mounting one end on a rocker rod, which is actuated by the same piston which moves the fuel injector. In very large boilers as many as three of these units may be mounted side by side. The ash is drawn off from trays between and at the sides of the units.

Automatic control may be provided for these stokers so that the only duty of the fireman is to dump the ash trays occasionally.

The second type of stoker is radically different in construction from those just described. In it, the fire grates take the form of a slow-moving endless belt, on which the coal is carried through the combustion chamber, being gradually consumed as it moves, and being dumped as ashes at the rear. This type of stoker is particularly adapted to very large boilers which have to meet sudden overloads, as those in large power-houses.

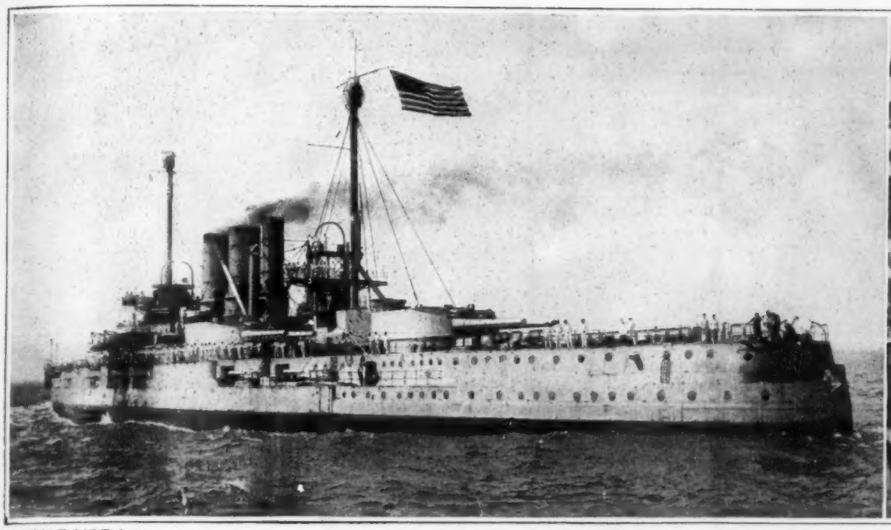
Forced draft is also provided here and by varying the volume of air drawn through the fire the speed of combustion can be closely controlled. By raising or lowering a gate under which the coal passes from a hopper on entering the combustion chamber the amount of coal can be quickly regulated. The draft and amount of coal must be so regulated that the coal is completely burned and only ash and not live coals is dumped at the rear. The grates may be driven by steam motors or turbines, using power from the boiler, or by electric motors.

The grates are made porous to allow the passage of air from beneath. One advantage of this type of stoker is that all of the burned material is dumped at each revolution of the grates and there is no trouble from clinkers or obstruction of the fire by ashes.

Not only have automatic stokers replaced hand firing in nearly every important power house, but they are very important equipment in some of our big industries. They are used for instance in many annealing furnaces and in the big forges where steel ignots weighing tons are heated. It is desirable in

(Continued on page 212)

Typical automatic stoker installations, showing the simplicity and neatness of the automatic system over the usual manually-fired equipment



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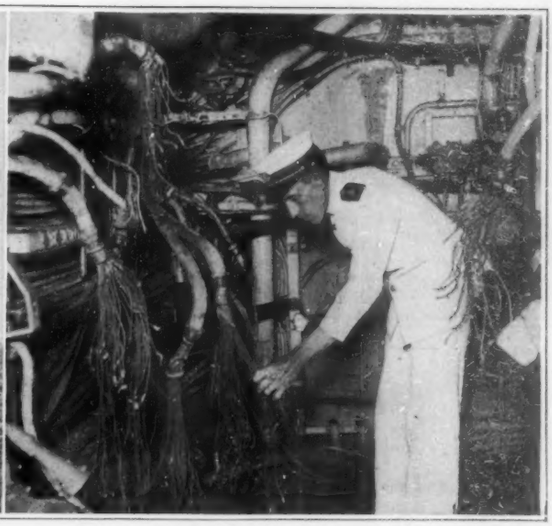
The surrendered German dreadnought "Ostfriesland" as she steamed into New York harbor. She will first be carefully studied and then shot up in target practice



This shows how the Germans wrecked the electrical wiring—the nerve system of the ship

The Surrendered German Battleship

IF anyone asks why the surrendered German warships have little or no value for the United States Navy, one suggestive answer can be found in the characteristic picture which we publish, showing the destruction wrought by German hands on these ships before they were surrendered. What they did to the electric wiring (which may be called the "nerve system" of a battleship) was matched by other destructive work to the fire-control mechanism, gun telescopes, range finders, compasses and a hundred other of the important details of battleship equipment.

The "Ostfriesland" formed one of the second group of dreadnoughts built for the German navy. Her sister ships were the "Thuringen," "Helgoland" and "Oldenburg." In designing them, the Germans repeated the tactical mistake which they made in the previous, or Westfalen, class; for they placed the six two-gun turrets in such a way that at no time, and on no line of bearing, can more than eight out of her twelve twelve-inch guns be brought to bear upon the enemy. These ships were laid down in 1908 to 1909, and it was not until five or six years later, when the Germans built the "König" class, that they placed all of the turrets on the central line of the ship—a practice which we have followed in our navy since 1906, when we laid down our first dreadnoughts, the "South Carolina" and "Michigan."

The "Ostfriesland" is a ship of about 23,000 tons displacement, with an eleven and three-quarter-inch main belt, reducing to six inches at the bow and four inches aft. The turrets are protected with eleven and twelve inches of armor, and the six-inch battery, which musters fourteen guns, has six and a quarter inches of protection. The ship has the great beam of 93¼ feet—this in order to allow for wide anti-torpedo spaces between the outside of the hull and the vitals of the ship. She is a triple-screw ship designed to be driven at twenty knots with 25,000 horse-power. Like all German battleships which were designed merely for the North Seas, her steaming radius is so limited that she would be useless for the world-wide activities demanded of ships of our own and the British navy.

Oil as a Locomotive Fuel

By Charles N. Winter

OF the many readjustments necessary to meet the changed conditions throughout the entire world, none is more important than the subject of fuel for locomotives, particularly in places remote from the sources of coal—the most commonly used fuel. The greatly increased cost of mining coal and transporting it long distances has raised the price to a point making its use as a locomotive fuel prohibitive in many parts of the world. This has a direct and far-reaching effect on the ultimate cost to the consumer of every necessity of life, hence concerns not only those who own and operate the railroads, but every person in every station of life.

Many experiments have been resorted to—burning of wood, maize, etc., but for general utility and economy oil has proved to be the most satisfactory substitute for coal as a locomotive fuel, and its use is increasing.

The coal shortage in Argentina led to a great increase in the use of wood, but due to its great bulk and the increasing difficulty of replenishing the supply, the hauling of wood became a great volume of the railroad traffic and threatened to become a monumental task. It soon was realized that more suitable fuel must be procured. Illustrative of the extremities resorted to in Argentina is the reported burning of maize as locomotive fuel. The fuel problem in that country has been partially met by equipping locomotives with oil-burning appliances and agents are now in the United States investigating the most economical methods of using oil fuel.

Pulverized coal is being burned successfully and experiments are being made with colloidal fuel—a mixture of pulverized coal and oil—but these methods require a somewhat complex apparatus and they cannot, as yet, be said to be generally applicable.

Another method being given consideration by some combustion engineers is the generation on the locomotive tender of producer gas which would permit the utilization of inferior grades of fuel now useless as locomotive fuel.

Oil-burning locomotives are by no means new, having been used in some parts of the United States and in other parts of the world for many years, but where coal has been available it has generally been used.

It will be interesting to those not directly concerned in railroad operation to learn of some of the means employed to burn oil as locomotive fuel. There are many different means employed to feed the oil into the locomotive firebox, but the general construction of such apparatus is substantially constant. Briefly the cycle of operation is as follows: The oil is fed by gravity from the oil tank, on the tender, through the oil heater and piping, to the burner, where it is vaporized and blown by a steam jet or a steam-and-air jet into the firebox and ignited by a piece of burning waste thrown in through the firedoor.

Two most important parts of oil-burning apparatus are the oil heater and the oil burner. One heater consists of a cylindrical chamber through which the oil flows on its way to the burner, and is heated by steam passing through the pipes contained in the cylinder. Another type reverses this procedure, the chamber containing the steam and the oil passing through the pipes. Still another type consists of two concentric tubes enclosed in a cylinder, the oil flowing between the surfaces of the inner and outer tubes and being heated by steam, which occupies the space inside of the inner tube and outside of the outer tube.

The use of the heater is resorted to in order to reduce the viscosity of the oil and at the same time to raise its temperature to a point just below vaporization before blowing it into the firebox.

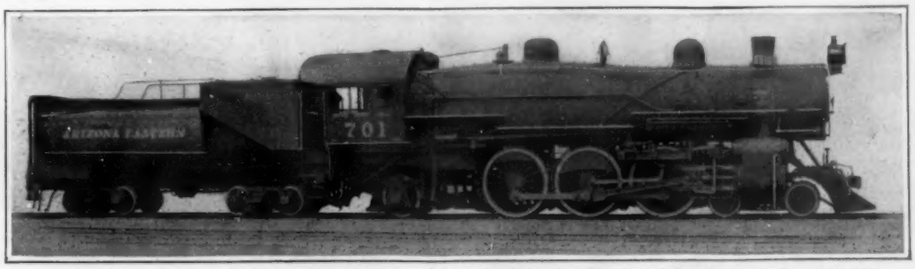
Numerous designs of oil burners have been used successfully, but they may be grouped into two general classes; those in which the oil and steam, or steam and air, mix and vaporize the oil inside of the burner; and those burners with which the mixing and vaporization takes place outside. Some burners of the outside-vaporizing type have a projecting corrugated lip which assists in atomizing the oil as the steam impinges on the corrugations. Usually in the inside-mixing type, the oil flows through the top chamber and meets a jet of steam and air which vaporizes the oil just inside of the outlet to the firebox.

The conversion of locomotives from coal burning to oil burning is comparatively simple and inexpensive. The oil tank can be installed in the coal space of almost any locomotive tender and the oil-burning apparatus installed in the locomotive itself with very little alteration to the firebox. This is already being done on certain divisions of a number of railroads in the United States. The Seaboard Air Line recently installed oil burners on all locomotives on a southern division of the road and has contracted for an immense supply of oil for a long period. The Santa Fe System, the Southern Pacific and other railroads of our Southwest have many oil-burning locomotives and are planning an increase in such equipment.

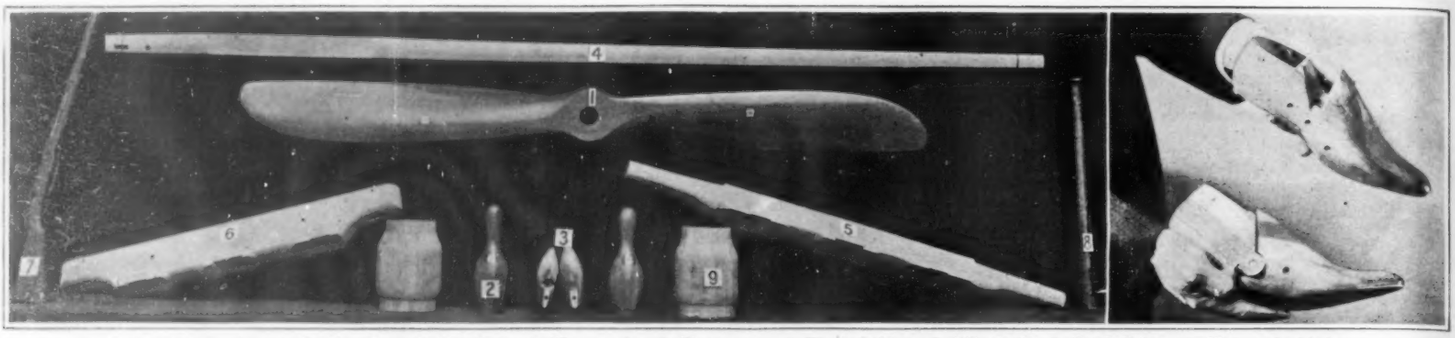
For months past the railways of France and Spain and other European countries have had engineers in America gathering data on the subject of oil as a locomotive fuel and the equipment of a great part of their locomotives with oil-burning apparatus is begun.

Fuel oil is found in many parts of the United States, in Mexico, in Argentina and other parts of South America, in Rumania, Russia and elsewhere, and as it may be handled with much greater facility than coal it is destined to come into more extended use as a fuel.

A conservative estimate of the relative heating value of oil is that three and one-half barrels of oil are equal to one ton of coal, which, at the prices of the two fuels, would effect a saving of from 20 to 40 per cent in fuel cost, to say nothing of the lower cost of handling oil as well as other operating economies. Thus, the ease with which the fireman can manipulate the oil-burning controls makes it possible to secure a very high degree of economy in the use of oil.



An American oil-burner having a tractive power of 40,000 pounds. Total weight of locomotive, 440,000 pounds; oil capacity, 2,900 gallons; steam pressure, 200 pounds



1. Aircraft propeller. 2. Bowling pins. 3. Shoe lasts. 4. Wagon pole. 5. Wagon axle. 6. Wagon bolster. 7. Rifle stock. 8. Baseball bat. 9. Wagon-wheel hubs. Separate views at the right show laminated shoe lasts

Typical articles of built-up plywood from the Forest Products Laboratory

Wood That Is Stronger Than Steel

How Thin Veneers and Water-Proof Glue Have Conspired to Build a New Industry

By Robert H. Moulton

THE weakness of wood is in its grain—the fact it is made up of a bundle of fibers. Each of these by itself will stand a considerable pull, but each fiber in the bundle is held loosely to its neighbors on all sides. To make a wood that is capable of standing strain in all directions, it is necessary to combine several layers cut at various angles to the grain. Thus is made "plywood," said to be literally "stronger than steel." It is revolutionizing airplane construction, and it will enter conspicuously into postwar industry. It is even possible that as a wall-covering the thinner varieties will compete with wallpaper; they possess all the beauty and durability of heavy wood paneling, for their composite nature prevents them from warping. Thin plywood has been found, in toughness and flexibility, to compete favorably with textile fabrics in the manufacture of airplane wings.

If anyone should say offhand that, weight for weight, wood was stronger than steel, he would be laughed at. However, the Forest Products Laboratory at Madison, Wis., which is responsible for our knowledge of plywood and the various uses to which it may be put, has devised a testing machine which proves this very thing; only, of course, the strength of the wood is estimated by the pull it will stand running with and not against the grain. For example, a toothpick of pine wood placed in this machine and weights applied, with the idea of pulling the toothpick apart in the middle, will usually stand a pressure of from 75 to 100 pounds before it gives way. As against this, a 3-inch length of steel wire, of the same *weight* (not the same daimeter) as the toothpick, generally gives way when the tension reaches about 30 pounds. Various tests with this machine have shown that all of the denser woods can beat steel by from three hundred to six hundred per cent. When tested across the grain, however, the best of wood shows only from one-fourth to one-half the strength of steel. That's why plywood was invented.

The panels used in the manufacture of plywood vary in thickness according to the article to be made of it. In the case of material for airplane wings, for example, they are only .01 inch in thickness. Gluing thin veneer into a very thin panel of plywood has always been an extremely difficult matter for the manufacturer. The principal cause of trouble has been the excessive swelling and shrinking of the thin plies due to their absorption of water from the wet glue, which causes overlaps and a considerable amount of wrinkling. A second source of trouble is in the handling of the very thin material when it has been coated with a wet glue, since it is very fragile and easily ruined when handled wet.

To overcome these difficulties the Forest Products Laboratory has evolved a process which consists of making a sheet of glue by coating thin sheets of tissue paper with blood glue, allowing it to dry, and using the coated paper as the glue layer for plywood. The process of making the panel then consists merely in laying alternately as many sheets of thin veneer and sheets of this glue tissue as may be required to build up the panel desired. These sheets are then pressed in a steam-heated press which activates the glue. The result is an extremely thin panel in which the moisture content has been changed not more than one or two per cent. This simple method eliminates the troubles resulting from the use of a wet glue, and makes the handling of the thin material an easy matter.

The extremely thin plywood secured in this manner and tested on airplane wings built especially for the purpose proved surprisingly strong. It was found that it gave between six and eight per cent added lifting power over the linen ordinarily used, by reason of the fact that the "flap" of the cloth is entirely eliminated. Weight for weight, its strength proved to be approximately the same, and it is quite likely that in the future all wings may be covered with this material.

When plywood was first thought of in connection with airplanes, an apparently insurmountable difficulty presented itself. A machine that had to be out in all kinds of weather and spend much of its time in a dense fog and in thick clouds—often approaching 100 per cent humidity for long periods—must not be held together in any way by glue that water would dissolve. To overcome this difficulty two new glues were evolved

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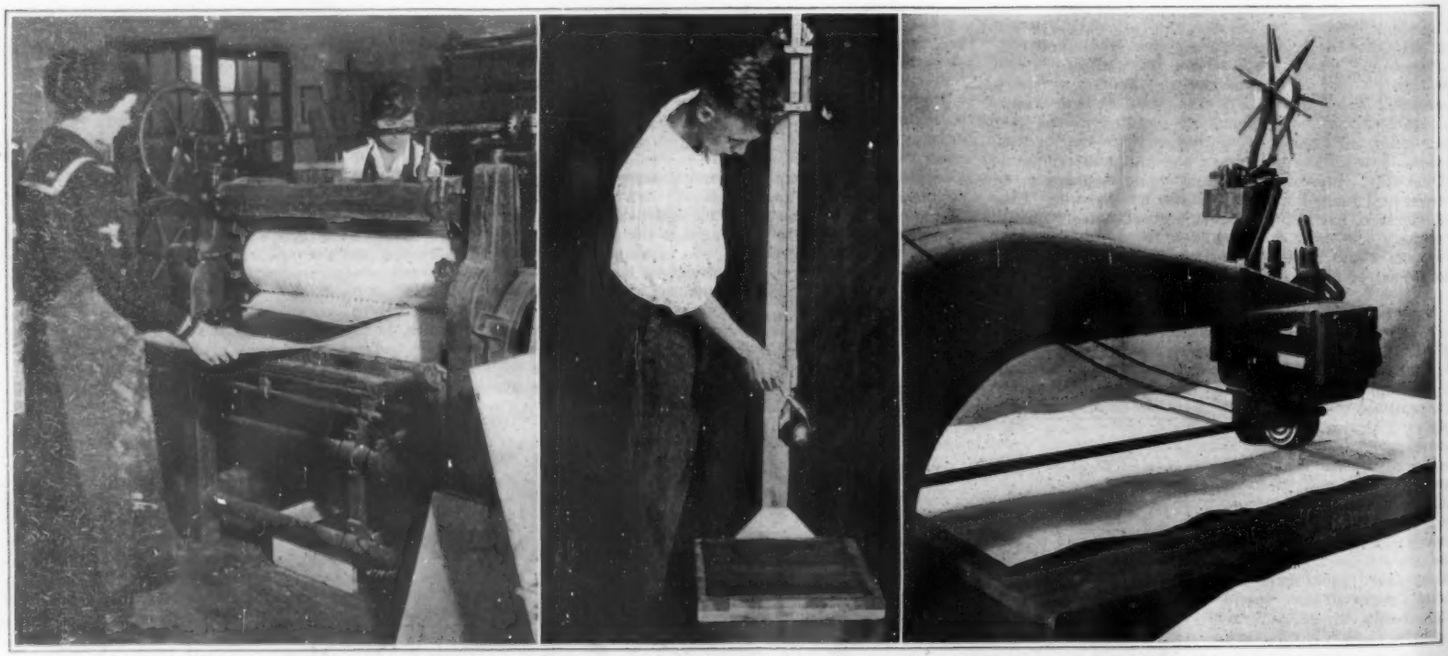


Left: Spreading casein glue on veneer sheets, the glue being applied cold. *Center:* The toughness test on thin plywood, in which the height is observed from which a steel ball must be dropped to splinter the sheet of veneer as it lies stretched over a hollow frame. *Right:* Machine that applies tape to the bundle of veneers, to hold the strips together prior to the application of the glue

The manufacture and testing of plywood at Madison

Fifteen stumps a day without dynamite

The Tripod Stump-Puller

THE direct application of the power to uproot the stump vertically instead of at an angle, so that the useful component of the force exerted is practically that entire force instead of half or less thereof, and the virtual absence of a hole to be filled where the growth is displaced, are among the virtues claimed for a tripod stump puller which we illustrate herewith. The machine is powerful and is capable of lifting huge stumps without the assistance of dynamite, although the use of the latter is a valuable ally in cracking the securely intrenched tree growth.

The tripod pullers, with respect to types, are threefold in number, screw, windlass, and lever machines, the last-named being more widely used. No anchor stump is necessary in using the lever pattern, the puller being set immediately over the stump and the machine is moved for each succeeding performance. The stump is displaced by chains encircling one of the larger roots.

The tripod stump puller has proven its efficiency in uprooting huge white and Norway pine stumps growing in the sandy soil of Michigan, and has a limited use in the Mountain and Pacific Coast States as well as the South. Four men and an equal number of horses constitute an efficient working unit, the Office of Farm Management, U. S. Department of Agriculture, having assembled data indicating that on five tracts of land crews averaged 79 stumps a day for over 140 days. The tripod machines cost from $125 to $200.—By *S. R. Winters.*

A Big Lifting Barge

THE accompanying picture shows the largest derrick barge on the Pacific doing a rather novel stunt—lifting a building tower at the shipyards, and moving the tower a distance of about one block. The tower weighs about 65 tons, is 65 feet in height, and carries two derricks on its deck, one of these being 100 feet in height.

A number of cables were connected to various parts of the building tower and the derrick barge walked off with it easily. Had it not been for this barge it would have been necessary to take the tower apart, which would have required much time and entailed quite an expense.

The new barge recently performed another novel job. It lifted a 150-ton deckhouse from topside of a steamer and with great ease deposited it on a nearby wharf. The task under the old system would have consumed several days and the labor of a gang of men. The work was done by cutting the deckhouse in half and transporting each 75-ton half.

A short time ago the derrick barge succeeded in pulling a new steel tanker from the mud after a number of powerful tugs had worked three days and failed. The owners were preparing to dredge around the tanker, which was on the mud a distance of about 50 feet. The top lift line and the heavy load line of the barge were connected to the tanker and she was pulled back into the water in half an hour.

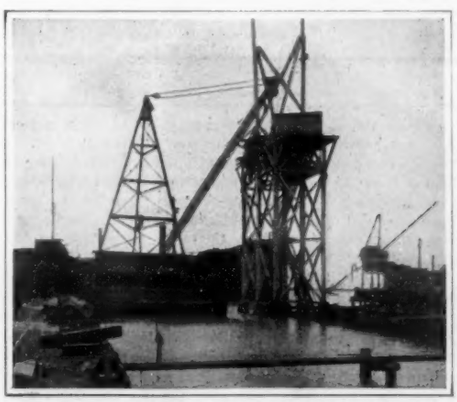
The steel derrick, it is estimated, will be able to lift the stern of a big vessel well out of the water so as to enable the workmen to replace a propeller, and the vessel would not have to go into dry dock. Above the wooden hull towers a triangular girder frame of steel 85 feet high. The boom is a lattice girder of steel 100 feet long and is designed to take 100 tons at a 50-foot radius and an 18-ton weight on its maximum working radius. Complete electric outfit is provided and a large air-compressor for working drills and other tools, or for supplying air to pontoons, or for forcing water out of wrecked hulls. Living accommodations are provided for a large crew of men and the barge carries sufficient fuel and fresh water to remain outside on a wrecking job for several weeks at a time. A feature of this barge is the hydraulic weighing machine. This device records the object lifted to the minimum of a pound.—By *C. W. Geiger.*

Barrel Rigged to Haul Water

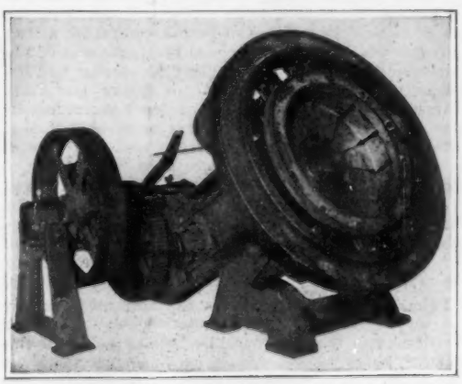
OFTEN the farmer needs to carry water about the premises in larger quantities than could be carried in a bucket by hand. Even if a water system is employed he does not care to install an extra conduit to such places as the temporary hog watering trough, the concrete mixing vat, the garden to water crops during an extended drouth, etc. The photograph herewith shows how one farmer rigged a 50-gallon kerosene barrel to be easily carried full of water by rolling it on the ground to any desired place on his farm Description of how this outfit is put together is superfluous.

The barrel is filled by removing the bung plug or stopper and then replacing it till arriving where the water is desired when it can be removed to draw out the water; the man whose outfit we illustrate has a faucet screwed into a hole bored in one of the heads to draw the water as needed, taking it out and putting in a short wooden stopper in its stead that will pass the shaft pieces when the barrel is rolling. The lag screws form spindles for the rear ends of the shafts to turn on and the load can be carried up considerable grades without much effort. One might think it would not be a paying idea to consume the necessary time to prepare this rigging but it is to be considered that when a haul is made with this barrel you have fifty gallons where it is needed, whereas you would perhaps not have more than two with a bucket. Nothing needs to be done to the barrel more than to bore a hole in one of the heads to draw off the water as desired if you prefer it to the bung hole in the side and there is but a trifle of expense to buy the material needed, only a few nails, two lag screws, a few scantling, etc.—By *L. M. Jordan.*

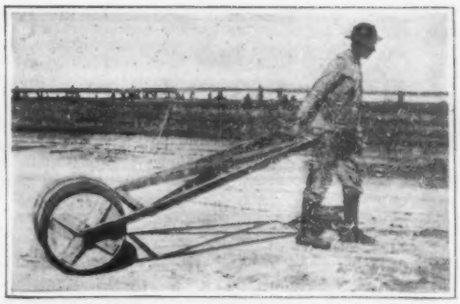
A "lawn" of concrete and green paint



Barge-mounted derrick that gives good service in San Francisco waters



Upsetting rims instead of expanding them



A handy substitute for the water bucket

The Concrete Lawn

THE waterless, mowerless, weedless, gopherless lawn has made its appearance in Los Angeles, according to a recent item in one of the local papers. Everything about this lawn is according to the usual specifications governing be-grassed and be-flowered front yards, with the single rather important exception that the "lawn" is of concrete, painted green. At a distance it doubtless looks pretty much like a grass lawn, though at close quarters we should think it might leave something to be desired, unless the proprietor (and inventor) has gone to the trouble of painting in individual blades of grass. The idea, of course, is to have a lawn that will stay fixed without any fixing—no mowing or cutting, no seeding, no rolling, no bare places, no trouble of any sort. Just how many people who care enough for the open to live in a neighborhood where the lawn problem exists, would be satisfied with this counterfeit presentment of a sure-enough lawn we do not know, but for all such, here is the idea.—By *Frank B. Howe.*

Mounting Pictures Smooth and Flat

HOW many times have you pasted down a paper or mounted a print to find that when it dried it had buckled disappointingly? Ordinarily the paste is applied on the mount, the difficulty being that the exact limits to be thus covered is a matter of guesswork to meet the uncertain expansion of the print which is immersed in water before mounting; with the result that the print often exceeds the predetermined limits of the amount of the area covered with paste to receive it; on the other hand the print frequently falls within this area, leaving a margin of irremovable paste. The following method is free from such objections and difficulties: Keep the mount flat and with a small wad of cotton wetted in clean water, slightly dampen the approximate area to be covered by the print. Cover the back of the print with paste—preferably arabol—smooth and thin. Apply the print to the mount and with aid of a paper blotter and a small roller, smooth the print from its center outward. No paste will appear outside the limits of the print; any dampness exceeding these limits will evaporate. Any paper shreds left by the blotter, etc., may be wiped clean from the print's surface with the same damp wad of cotton.

Tire-Rim Upsetting Machine

IN welding tire rims the method commonly used has been to weld the rim with the diameter less than the size required, and afterward expand the rim while cold to the correct diameter. For this purpose a tire-expanding machine was used and a low carbon steel is required as high carbon steel is more liable to break in the stretching process. In order to use the upsetting principle to obtain the correct diameters a new machine has been developed by a Chicago manufacturer. This machine contracts a tire rim to the correct size instead of expanding it. It differs from the usual tire setting type of machine in being motor driven instead of employing hydraulic power and the rim is held nearly vertical instead of in a horizontal position while being contracted. A toggle motion controls the jaws or dies and a combined movement of 3¼ inches across the diameter of the circle is obtained. The machine in operation runs continuously and makes eight strokes per minute. A wedge adjustment operated by a hand-wheel is provided to take up wear or to suit special conditions.—By *Allen P. Child.*

Items In Brief

A Department Devoted to Current News in All Fields of Pure and Applied Science

Power and Fuels

The Gasoline Situation.—There is no mystery in the existing shortage of gasoline on the Pacific Coast. It is not a case of diminished supply—the Far West has never had so much gasoline as this year—but one of increased consumption. The refineries of California are this year manufacturing a greater volume of gasoline than last year, and great quantities are being brought to the Far West from Mid-Western fields and Mexico. Yet, this larger supply does not satisfy the enormous demands of the scores of thousands of additional automobiles, trucks, farm tractors, gas engines, pumps and other equipment dependent upon gasoline for power.

A New Heating System.—Building superintendents and heating engineers will be interested in a piping layout for a heating system that provides a closed-loop circuit, whereby the water of condensation from the radiators is returned directly to the boiler. With the system is used a duplex boiler feeder, according to *Power*, which permits a continuous flow of condensation into the boiler. The condensation is held under pressure and is delivered into the boiler at a temperature only one or two degrees below that of the steam, corresponding to the pressure carried on the heating system. These results are obtained without the use of a receiving tank. There are no vents open to the atmosphere and practically no heat loss.

Cleaning the Air for internal combustion engines without materially reducing the engine power is a problem that has received considerable study, and a number of devices for the purpose have resulted. One of the more recent of these deposits the dust on the walls of a winding passage kept wet with oil. The upper portion of a disk which revolves at about ten revolutions per minute, intercepts the air, and as the revolution continues, the dust is washed off and settles in the oil bath, from which it is removed as required. Cleaning the device is said to be an easy matter. It is claimed that power loss due to the cleaner is greatly reduced because the air is not required to pass through the oil and the air flow is therefore not strangled.

Natalite—A New Motor Fuel.—It is reported by the London Automobile Association and the daily press that natalite, the new motor fuel (so called by reason of its discovery in Natal, South Africa), has been in use in that country for some time past, is well spoken of, and has had many favorable reports upon its practicability as a gasoline substitute. It is said to be a by-product of the Natal sugar industry, and is reported to be a mixture of power alcohol and ether, capable of great development, in view of the large tracts of waste vegetation available in South Africa. A British research committee is now engaged in making regulations respecting the use of this fuel, especially the necessity of denaturing the liquid to prevent its possible use as an intoxicant.

Transportation

The U. S. Navy's Swiftest Vessel.—Steaming at the rate of 38.257 knots, the U. S. "Satterlee" in her recent official trials broke all American speed records. The best previous record made by an American war vessel was 37.04 knots. The "Satterlee" is driven by two 14,000-horse-power Westinghouse compound turbines which developed 31,223 horse-power and broke all records for vessels of this, the destroyer, class.

The Very Necessary Horse.—The regular dealers in New York City who make a business of purchasing high-class draft horses and assembling them in pairs report that they have never had such a demand for good draft horses and that prices have never been as high as during the months of March, April and May of the present year. The reason for this is that horses and mules are still the chief source of motive power in agriculture and draying. They have been read out of existence a good many times in the world's history. Nevertheless, the United States Census for 1910 revealed 19,833,000 horses and 4,210,000 mules on farms, and the estimates of the Department of Agriculture for January 1, 1920, show 21,109,000 horses and 4,995,000 mules on farms, an increase of 1,276,000 horses and 785,000 mules in the last decade. In addition to this, we exported in the nine-year period ended June 30, 1919, 1,149,763 horses and 376,836 mules.

Growth of American Shipping.—On June 30, 1920, the close of the fiscal year, the shipping registered, enrolled or licensed under the American flag, according to the official returns of the Bureau of Navigation, Department of Commerce, comprised 28,150 vessels of 16,350,000 gross tons. Final returns of smaller vessels built, lost, or abandoned will change slightly these figures one way or the other, but probably not to the extent of 100 vessels and 12,000 gross tons. Since January 1, 1919, closely following the armistice, American shipping in round numbers has increased 5,000,000 gross tons, and during the fiscal year just ended the increase has been 3,400,000 gross tons, of which 3,100,000 gross tons are documented in the name of the Government, represented by the Shipping Board.

Again, the Hydraulic Propeller.—The principles of operation of the Hotchkiss hydraulic propeller are, briefly, the formation of a vortex in a drum or casing, by the rotation of an impeller, the vortex discharging tangentially to give the thrust, and being fed in the direction of rotation by two converging streams which meet immediately over the discharge stream. By rotation of the drum casing the discharge stream may be moved so as to flow through a reversing port, and thus maneuvering can be carried out independently of the direction of rotation of the engine. The drum casing is carried in an outer drum or casing containing the reversing port; a further movement of the control lever rotates the inner drum until both the inlet ports and the discharge cutting are masked by the outer casing. The propeller is, therefore, converted into a sealed drum, with neither inlets nor outlets, and since pumping ceases, all of the load other than frictional is taken off the engine, and a hydraulic clutch is the result.

Engineering

Fitting the Roof to the Factory.—Too little attention is generally given to the roof of the factory by the architect, when, as a matter of fact, the roof is just as important as the floor plan. Indeed, there are several types of roof available today for factory purposes, and the plans of any factory should always take into consideration the type of roof best suited to the requirements.

Making Money By Destruction.—Owing to the high cost of building materials, about one-third of the materials from a house-wrecking operation may be used again for building purposes. Formerly the house wrecker's chief concern was to take down the construction in the least possible time and at the least expense to himself; but today he also figures on ways and means of removing said construction with such care as to secure much valuable building material. It is well within the memory of most of us when salvaged bricks sold for $1.00 a load with 2,000 bricks to a load. Today salvaged bricks bring $10.00 and in some instances as high as $15.00 a thousand.

Sea Bathing in Paris, which, as everyone knows, is an inland city, is soon to be realized. Water from the sea is to be conveyed to the French capital by a long pipe line which has been planned by M. Alvarez of the Department of Roads and Bridges, as corollary to the scheme for bringing "mazout" or heavy oils from Havre to Paris by means of pipe lines three feet in diameter. Two such pipe lines are to be built, and a third line is planned for conveying sea water to a huge reservoir near Paris, where tired workers might rebuild their vigor and health over Sunday. The great cost of the pumping installation has stood in the way of the project, but it has now been suggested that the pumps be reversed during winter months for the purpose of pumping water from the Seine to the sea, in this manner reducing the danger of floods.

Points on Roads.—As loads are transmitted from the wearing course to the foundation and from there distributed to the subgrade, the bearing power of the soil composing the subgrade is an important factor in the design of the highway. It is well known that the bearing power of soils in many instances is materially increased by efficient drainage. The roadway, therefore, should be drained so that the maximum wearing power of the subgrade is developed, according to A. H. Blanchard, S.A.E. While a poorly drained roadway might support a light rural traffic, it will be rapidly destroyed if subjected to commercial motor transport including, for example, several five-ton trucks. The greatest improvement noted in American foundation practice is the use of cement-concrete foundations, or stone foundations of equivalent strength, on State trunk highway systems.

Organic Impurities and Concrete.—Tests made in the Structural Materials Research Laboratory with the coöperation of Lewis Institute and the Portland Cement Association show that the long recognized injurious effect on concrete of organic ingredients is a fact. The following conclusions were reached: The strength of concrete was reduced for all percentages of tannic acid, for all mixes and ages covered by these tests. Less than 0.01 per cent of tannic acid in terms of the weight of the aggregate may reduce the strength of the concrete to one-half its normal value. Lean mixtures are more affected by tannic acid than rich ones. The mixtures from the finer aggregates are less affected by tannic acid than those from the coarser aggregates. All of the effects mentioned may be summed up by saying that the reduction in strength of concrete is a function of the concentration of tannic acid in the mixing water.

What Makes Rails Wear Out?—It is pointed out by an authority that the ordinary car traffic is not entirely responsible for rail wear. The constant traffic of ordinary road vehicles has a considerable wearing influence. In a general way rail wear is dependent on the operating speed of the car, weight of equipment, density of traffic, use of brakes, frequency of stops, grades, alinement with respect to curvature, design of rails, design of wheels, upkeep of wheels, use of sand, cleanliness of streets, and manufacture and composition of the rails. Curves prepared by this authority indicate that a traffic of 216,000 cars at a speed of 18 miles per hour produced in three years the same wear as a traffic of 320,000 cars at a speed of 9 miles per hour in four years. In a single-track line the wear is seldom greater, and is frequently less, than in a double-track line: an apparent paradox which is probably explained by the reversal of direction of traffic, which tends to neutralize cold-rolling actions in the surface of the rail-head.

Industrial Progress

Belgium's Diamond Industry.—The number of union workers in the diamond industry in Belgium reported to be out of work is 6,500 out of a total of 12,000. Owing to a falling off of the demand for cut stones, employers are seeking to decrease wages 35 per cent. The diamond workers' union has objected to this, and is unwilling to accept a diminution of more than 15 per cent. The matter is being arbitrated. In the meantime hundreds of employes are seeking other work.

Italy's Mining Industry.—Among the Italian industries which progressed most during the war was the mining industry. In 1914 it comprised 1,062 mines, employed 46,412 workmen, and the output was valued at 96,500,000 lire. As regards amount of mineral extracted, the sulfur industry came first with 2,371,705 tons of ore, followed by coal and lignite, with 781,358 tons of product; iron ore, with 706,246 tons of product; iron pyrites, with 335,531 tons; and asphalt, zinc and mercury. Since 1914 Italian mining activity has been directed with more or less success toward the following ores: Iron, manganese, copper, lead, zinc, gold, antimony, mercury, tin and mixed ores; also toward iron pyrites, anthracite and lignite, ichthyolitic and bituminous schists, sulfur, rock salt, salts from springs, petroleum, carburetted hydrogen gas, mineral waters, asphaltic and bituminous rock, raw bitumen, aluminite, boric acid, and graphite.

Spitzbergen's Natural Wealth is again brought to our attention by the *Times Trade Supplement*. It is said that a totally new and, until the last few years, quite unsuspected source of fuel oil exists in Spitzbergen. The existence of oil-bearing shales in this far-off land has been known for some years. It is not

generally known, however, that a discovery of much greater portent than the existence of shale was made there last year. Samples of gas which bubbled to the surface of muddy pools have, on analysis, proved to contain an exceedingly high percentage of petroleum elements. Arrangements have been made by the owners of the territory thoroughly to prospect the region at once. There is great scope for industrial development in the islands, for, continues the *Times*, though only a small portion of their area has so far been prospected, during the past few years they have been proved to contain much mineral wealth.

Cologne's Permanent Exposition.—Cologne is planning to inaugurate a permanent exhibition, known as "Musterschau," mainly for raw material and half-manufactured goods. It is intended that special exhibitions will be held periodically. For the use of the exhibition two large halls of iron construction, 4,000 and 7,000 square meters, respectively, are already in the course of erection, to which smaller buildings will be added according to requirements.

Italy's Floating Sample Fair.—The success of the sample fair held both at Milan and at Padua seems to have been sufficient to stimulate further interest in this plan of developing sales. It is claimed that at the Milan fair actual orders amounting to 500,000,000 lire were taken. Figures for the Padua fair are not yet available. The latest project of this kind is that of a floating fair on board the steamship "Trinacria," which will cover the principal cities of the Western Mediterranean in the interests of Italian manufacturers. The length of the stay in each port will vary in accordance with its importance, from four to seven days. The cost to exhibitors will be 5,000 lire, in which all expenses are included.

Signing Foreign Correspondence.—Those who are familiar with commercial practices abroad understand that all correspondence addressed to foreign business houses should be signed by some one in authority—a member of the firm in the case of a partnership, or an officer of the company, or at least the export manager in the case of a corporation. It appears, however, that there are many American firms who use a rubber stamp, or the signing is done by some clerk occupying no position of authority. In a number of cases this has been unfavorably commented upon by European business men, who, quite naturally, wish to deal directly with the principals, and to be assured that the firms with which they are dealing are prepared to stand by the statements made in their letters.

Automotive Progress

Wood Disk Wheel.—An automobile disk wheel made of wood has recently made its appearance after a series of tests both on the road and in the laboratory, according to *Automotive Industries*. The construction, which resembles in appearance the steel disk wheel, is of thin, rotary cut slices of wood, glued together under heavy pressure. The laminations are so built up that the grain of each piece runs in a different direction from that of the next piece, thus producing a result that is claimed by the makers to be strong, non-warpable, and thoroughly waterproof. Road shocks, it is declared, are distributed evenly.

Steam Wagons.—Europe, and England in particular, has long stood by the road locomotive which resembles nothing more than our steam road rollers. Now there is being developed in England a steam wagon which follows the general lines of the conventional gasoline truck. However, the steam power plant makes use of a regular boiler and firebox for coal. The framing of the wagon chassis is of pressed steel instead of the more usual channel iron, thus permitting of a lighter structure and one better proportioned to the stresses it has to carry. The final drive from the engine to the road wheels is by means of a pitch chain, as usual in vehicles of this type.

French Automobile Manufacturers are considering the United States as a market for their cars, according to a recent dispatch from Paris. Mr. Pierre Bassett, representative of the Syndicat Français des Constructeurs d'Automobiles, will leave France shortly to investigate conditions here and on the basis of his report will map out their sales campaign. Due to the French exchange situation and the low cost of freight space on ships returning to the United States, Mr. Bassett expects to place French trucks on sale here at prices which will compare favorably with local prices. Moreover, many of the large French concerns have developed considerable technique in fast construction. Their appeal will be directed toward customers in this country who are willing to pay the higher price for "something different."

Magneto or Battery Ignition?—Considerable interest has been expressed by engineers as to the relative power output of engines equipped with magneto and battery ignition, respectively. A test was recently made at McCook Field, Dayton, Ohio, for the purpose of comparing the results obtained with both types of ignition. A 180-horse-power Hispano-Suiza was equipped with a magneto for part of the test, and then with special battery ignition. The difference in performance was very slight. Practically the same power was obtained using either system. The gasoline consumption remained about the same in each case. However, as regards weight, the two magnetos, weighing 14½ pounds each, one starting magneto of six pounds and one switch of one pound, made a total of 32 pounds, while the battery ignition, calling for the motor units, distributors, breakers, coils, and so on weighed altogether 30 pounds, the ignition battery 10 pounds, the switch and regulator 2 pounds, giving a total of 42 pounds.

Communication

The Chinese Wireless Station at the Temple of Heaven, Peking, is open for service. All the telegraph offices in the city are accepting radiograms at the same rates as those charged for land-line messages for transmission to Kalgan, Wuchang, Woosung, Shanghai, and Foochow. Special rates apply to radiograms sent to ship and aviation stations. This service gives Peking improved communication with some of the most important commercial centers in China.

The Rome Wireless Station.—It was in 1917 that the Italian Government planned the wireless station at Basilica of San Paolo, near Rome. It was decided on account of the necessity of rapid construction to use continuous waves, and for similar reasons the Poulsen arc system was adopted. The antenna chosen was one having the shape of an equilateral triangle supported by three cables more than 200 meters high, with down leads coming from one of the sides. The station is quite capable of receiving messages from American high power stations, but its transmitter does not maintain continuous touch with the American stations.

Marconi's Wireless Telephone.—In his recent experiments Marconi used a 15-kilowatt, 500-volt, 200-cycle generator supplying current to a 20,000-volt transformer, tapped at the secondary middle point. Two rectifying valves cause a condenser to be charged to half the total secondary voltage uni-directionally once every half-cycle, maintaining the condenser charge at about 10,000 volts for the supply of the transmitting and low frequency magnifying valves. To eliminate the distortion of the harmonics in the speech waves, and to obtain the best quality of speed it has been found that the best method is to absorb the energy in the aerial in accordance with the speech wave formed. This is effected by stepping up the microphone current to produce voltage curve similar in shape to that produced by the varying current caused by speech by means of a two-stage low frequency amplifier. The voltage variations are thus magnified and are impressed on the grids of the absorption valves. As is well known, the resistance of a three-electrode valve varies with the voltage impressed on the grid, so that in this case the conducting power of the absorption valve varies with the voltage curve produced by speech.

Electrical

Production of Electric Lamps.—For the year 1919 sales of all kinds of lamps in the United States amounted to 183,000,000, and although this is 3,000,000 less than in 1918, the diminution is not substantial. An interesting feature is the diminution in the percentage of carbon filament lamps made. This has fallen from 11 per cent to 7 per cent in 1919. It is also interesting to note the increase in the use of gas-filled lamps, of which 24,000,000 were sold in 1918, as compared with 27,000,000 in 1919—a rise of 12½ per cent. Most interesting of all, no doubt, is the fact that the average candle power of lamps is steadily increasing.

National Electrical Safety Code.—The present edition of the *National Electrical Safety Code* was issued in 1916 for examination, trial and constructive criticism. It was realized that the code was not a perfected document and that experience should be obtained with it before the rules were made mandatory. War conditions delayed the expected trial, and although revision has been almost continuously under way, it was not until the present year that sufficient information and consideration of the rules could be obtained to warrant the publication of a new edition.

Electro-Pneumatic Welding Machine.—In operating spot-welding machines of the usual type the pressure required for the weld is produced by a foot pedal. This is tiring to the operator, especially as he may have to make 15,000 welds per day. The electro-pneumatic welding machines now being built in Germany are equipped with a compressed-air cylinder controlled by a foot pedal, which requires very small effort to depress. The motion may also be regulated by a small motor that actuates the mechanism a given number of times at the required intervals. By this device the capacity of the welding machine may be increased by 50 per cent.

Electrification of Japan's Railroads.—According to the provisions of the bill introduced in the Diet for the complete electrification of the railroads of Japan, the Government would invest 50,000,000 yen in a semi-governmental electric power company, which would be capitalized at 100,000,000 yen, the other half of the capital stock to be subscribed by Japanese citizens or bodies incorporated under the laws of Japan. It is further understood that the Japanese Government contemplates erecting the largest hydro-electric plant in Japan on the River Shinanogawa near Tokio, which would probably be supplemented by a large steam plant also near Tokio.

Remotely Controlled Electric Locomotives.—In a recent issue of the *Electric Journal* there appears an interesting account of a remotely controlled electric locomotive. The motorman first brings the locomotive with eight empty cars and spots the first car under the loading chutes at the screen station of the coke plant. The motorman then throws a switch and places the locomotive under the control of the operator in the screen station and leaves the locomotive. The operator then slowly moves the train forward, stopping or reversing it as conditions may require, thereby securing an evenly and completely loaded car. When the cars are loaded the motorman returns to the locomotive and draws the cars to the classification yards, returns for empty cars and the cycle is completed.

Chemical and Metallurgical

Alloyed Aluminum.—Much progress has been made of late in the development of new aluminum alloys, especially for use in the automotive industry. The most sensational step, according to a leading authority on this subject, is the evolution of a forging alloy which promises to accomplish much in automobile engine design, in the way of cutting down the reciprocating weight and in reducing rotating masses and bearing pressures. The physical properties which have so far been secured in the forging alloy are said to be 55,000 to 65,000 pounds per square inch tensile strength, with 18 to 22 per cent elongation and 38 to 40 per cent reduction in area.

Use of Manganese.—Approximately 95 per cent of the manganese consumed in the United States is used in making steel not only to deoxidize and recarburize the molten metal, thereby making possible the production of cleaner and sounder ingots containing the desired amount of carbon, but also to impart certain qualities to the finished product. Small proportions of manganese, 0.5 to 0.8 per cent, make the steel easier to work and stronger in service. At the same time slight proportions of impurities remaining in the steel are taken into combination and rendered less harmful. Relatively small quantities of so-called "manganese" steel are made which contain 11 to 14 per cent or more of manganese and possess special qualities of hardness and strength.

Electrolytic Purification of Clays.—The electrolysis of colloidal solutions has led to the application of this principle to the purification of china and other clays. If clay is mixed with water and certain alkalis are then added to the solution, the mixture settles and becomes more liquid. If, now, an electric current is passed through the solution, the particles of clay connect at the anode, while the impurities (mica, felspar, quartz, iron compounds) either are precipitated or migrate to the cathode. On an industrial scale the process is carried out in a large vat, in which slowly rotates a metal cylinder forming the anode, and near which the cathode is placed, continues *L'Industria*. The clay paste, after the electrolyte is added, is left to clarify in other tanks, being then passed into the electrolyzing vat for final purification, when it is collected by special rakes. In addition to being pure, clay thus treated has a lower temperature of agglomeration, molds more easily, and is more plastic and refractory.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Speaking into this telephone, the guard projects his voice through several loud-speaking telephones

An Electrified Voice for the Subway Guard

RELIEF from the inarticulate sounds emanating from the guards in announcing subway stations is in sight. It is to come in the form of a loud-speaking telephone developed by E. E. Trafton, telephone engineer of the Brooklyn Rapid Transit system of Brooklyn, N. Y.

It is claimed that the operation of the new loud-speaking telephone entails little effort on the part of the guard, who speaks in an ordinary voice through a transmitter located at the central panel which contains the push-buttons controlling the doors of the car. Loud-speaking units are installed on the ceilings of the car, so that the voice of the guard is greatly amplified and distributed throughout the car. The transmitter, into which the guard speaks, is provided with a button for throwing it in and out of circuit, as well as a peculiarly-shaped mouth piece with four petals instead of the usual cone shape.

Speeding Up the French Fried Potatoes

THOSE French fried potatoes which many of us ordered when porterhouse steak was within the reach of us all, are not easily prepared unless some special device is used for the cutting. Here is one that has been invented recently and that seems to put speed into the preparation of this much favored item of the menu card. Mounted on the top of a nickel plated hollow base is a square surface across which numerous cutting blades are strung. By pushing the potato through the cutting squares they fall below ready to be cooked.

Pushing the potato down on this device paves the way for French fried potatoes

For Handling the Camper's Baked Potatoes

THOSE of you who are camping or who are planning a trip out into the great out-of-doors in the future will find this newly-designed cooking utensil useful. It is called a pusher fork. By manipulating the spring handle, corn or hot baked potatoes can be picked up and served on a plate without burning the fingers. Our illustration shows the potato being pushed from the fork. By releasing the thumb on the spring handle the small "pusher," which slips along the tines to the end, will fall back into position near the point where the tines join. The "pusher" cannot go beyond the end of the tines.

There need be no burnt fingers when handling potatoes with this pusher fork

More Heat from Less Coal

THE older houses and apartments in the Malmo section of Sweden are provided with very simple cast-iron cooking stoves. The newer buildings, however, are equipped with gas cooking apparatus almost exclusively. Gas is available in nearly all cities in southern Sweden, and is more generally used for cooking than for light. Buildings constructed more than 10 years ago have few furnaces, but are heated by high tiled stoves, which are characteristic of all Scandinavian countries. These tiled stoves can be opened so as to produce a fire-place effect. The new houses, villas, and apartments are provided with furnaces burning coal or coke. Hot-water heaters are more frequently found than any other kind. The coils and radiators are quite modern in design and compare favorably with those in use in other progressive European countries.

Most of the heating and cooking apparatus is produced locally in the industrial region of central Sweden. The principal imports before the war came from Germany. The Germans shipped more gas cooking stoves to southern Sweden than other kinds. The German stoves are more modern than those produced in Sweden. Imports from other countries were small.

Agricultural Exposition to Be Held in Belgium

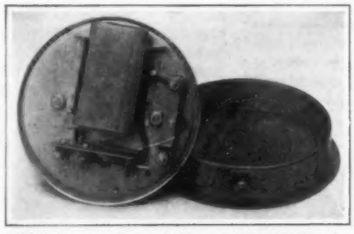
THE legation of Belgium at Washington has announced that an exposition of agriculture and agricultural husbandry will be organized at Laken-Brussels in September, 1920, under the patronage of the Ministry of Agriculture of Belgium. The object of the undertaking is to bring together the implements most useful to agriculture—machinery, furniture, experimentation, and instruction.

The Minister of Agriculture of Belgium has expressed a wish that the exposition be made known to the industrial and scientific special centers which in the United States are most interested in the furniture, apparatus, and implements, and also the methods and arrangements by which labor can be saved on the farm and in the rural household.

Firms interested in an exposition of this kind can communicate with Mr. De Vuyst, Director General of the Ministry of Agriculture, Place Quételet, at Brussels, with a view to sending to the exposition all novelties and specialties that come under the head as above outlined. Exhibits which the owners would be willing to leave to the superior normal institute of agricultural husbandry after the exposition would be used in the museum that would be periodically opened to the public.

Bringing Buzzer and Battery Together

A NEW design of electric buzzer has appeared that does not require a dry cell outside of the bell itself. The buzzer uses a flash-light battery which is concealed within the casing of the bell. It is so made that it can be operated at some distance or by using the push buttons installed on the buzzers. The binding posts on the right and left of the push button can have proper wire connections for some outside use of the buzzer. In the bottom of the metal case, upon which the bell is mounted, is a small door. By opening this a worn flash-light battery can be removed and another pushed into its place. The coils of the electromagnets are wound for about 8.5 ohm. where a 2-cell battery is employed. Buzzers are all made for the 2-cell battery, with a 2½ gong.



This buzzer is entirely a self-contained unit, having its own battery

Polishing Brass Buttons Without Spotting the Uniform

IT has come to be a popular belief that women are not inventive. Yet time and again we find some ingenious idea conceived by a woman; and the truth of the matter seems to be that women, unlike men, do not invent unless they are driven to it, so to speak. In other words, women will invent through sheer necessity.

Such is the case with Mrs. Hannah Schachne of New York City, the wife of a policeman, who has invented a new and less tedious method of cleaning buttons on all uniforms. Mrs. Schachne has been cleaning her husband's brass buttons for years and great care has had to be exercised not to spoil or ruin the cloth around the buttons. So in her search for a better way to do this work, she invented the simple shield shown in the accompanying illustration. The action of the shield is self-explanatory.

Copyright, Keystone View Co.

This simple shield protects the uniform while the buttons are being polished

A New Partnership: Phonograph and Alarm Clock

IT may be that the war has something to do with it; so many of our young men have learned to get up in the morning to the tune of the "Reveille" that it is hard to get along with the more conventional alarm clock. At any rate, Oscar Lindholm, a machinist of Chicago, Ill., has invented the alarm clock-phonograph, shown in the accompanying illustration. In this device use is made of a standard alarm clock for the purpose of starting the turntable of a standard phonograph. The clock can be set for any desired time. When the clock "goes off" it starts the turntable of the phonograph. In this manner it is possible to vary one's rising call. One day it may be a good cornet solo; again it may be a popular song of the moment; still again, it may be a crashing military march. Or if one desires a personal tone in the summons to arise, it may be a man's or woman's voice. At any rate, the phonograph has another useful mission to perform.

The alarm clock starts the phonograph which plays any desired music to get one out of bed

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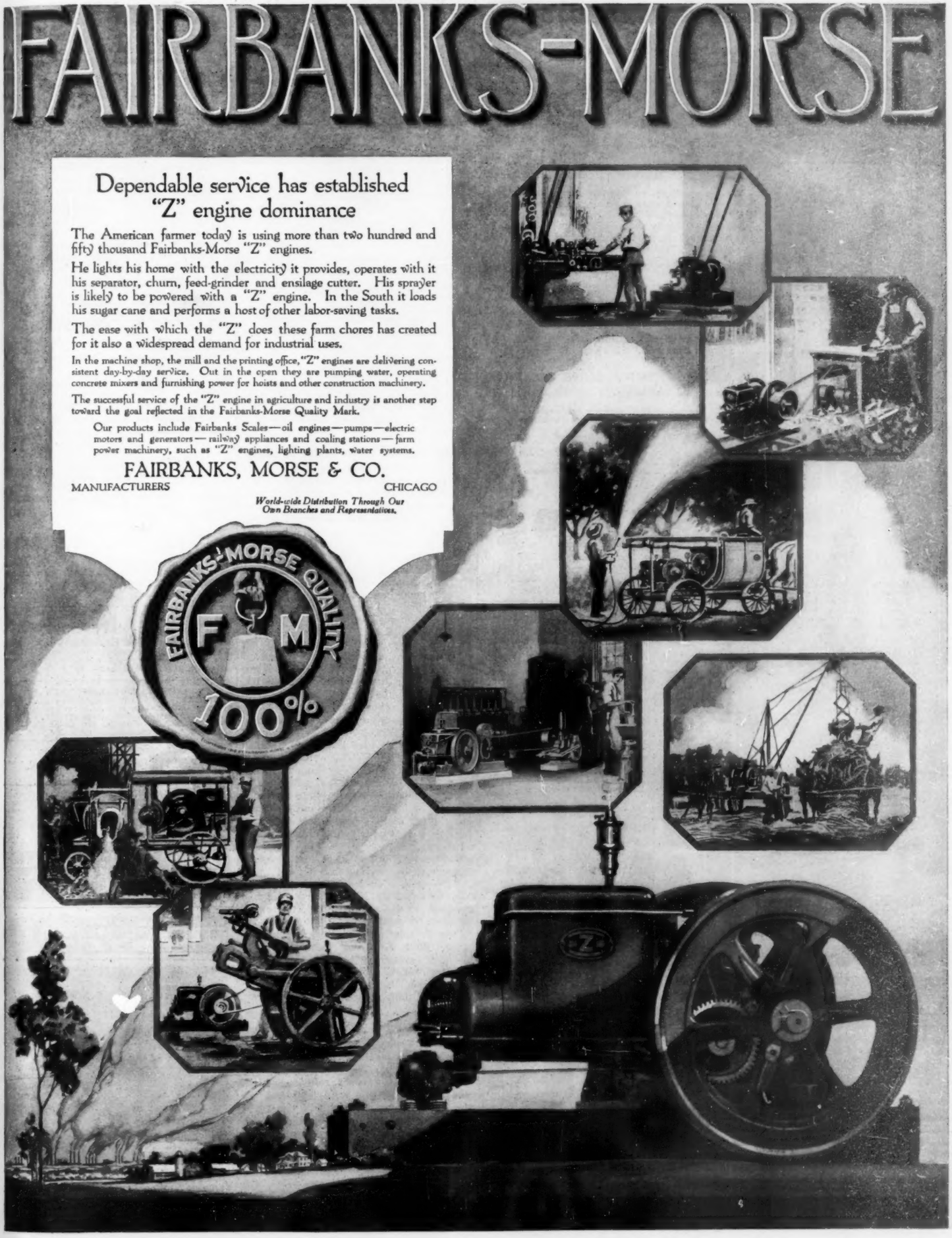

Stale Air Out Fresh Air In

YOU can't get fresh air **in** unless you get stale air **out.**

Generally the stale air rises at first, because it's warmer than the fresh outside air. Give it free exit near the ceiling, at the same time opening inlets near the floor, and the stale air slips quietly out while fresh air takes its place.

But if the stale air is kept indoors it presently cools, descends, and mixes with the lower air. Thereafter the stale air cannot be separated from the fresh air unless there is a wind blowing across.

With properly-placed **upper and lower** ventilators, even a wide building will have fresh air. But how many buildings do you see that have only one row of ventilators, located about midway of the sash height? Such a building cannot be adequately ventilated without a cross wind.

The building here shown is an example of good design, using Lupton Pivoted Factory Sash with connected upper and lower ventilators. We are always glad to advise intending builders regarding the best choice and arrangement of sash for their special needs.

We have published an interesting booklet, "Air, Light and Efficiency." It's free on request.

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New York's Radio Pilot Cable

(Continued from page 195)

breaking the cable current in order to transmit signals; in fact, an automatic sending apparatus may be installed so as to send out given signals over and over again when necessary.

So much for the cable. Now the receiving end aboard ship is quite as simple. Two coils are required, each four feet square and wound with 400 turns of No. 24 S.C.C. copper magnet wire. Care should be exercised in making these coils so that each coil will have the same resistance and inductance values. Much depends upon this precaution as the signal strength received by each coil is the function of the resistance of each coil, and should their resistance be different, a signal strength of different intensity will be received by each coil when at the same distance from the cable. The best shape for the coils is the pancake. The wire can be wound in pancake form four feet square, with a winding space of one inch. The coils are impregnated in paraffin and then placed in wooden boxes with more paraffin in order to protect them from abrasion.

The coils should be placed over the side of the ship approximately amidship, one coil on one side and the other coil on the opposite side, below the surface of the water or slightly above the water line.

Gas Engine Versus Steam Engine

(Continued from page 197)

tion by means of these two modern vehicles, which, coupled with the good-roads movement in California, are re-forming the whole social and industrial world.

California is one of the foremost States in the Union in the voting of bonds for the construction of good roads. The work was begun in 1909 when the State Highway Appropriation Act provided for a State bond issue of $18,000,000 for the construction of highways. The work of construction was begun as soon as this fund was available. But the enterprise loomed so large, as the work went on, that the fund provided appeared entirely inadequate. Accordingly on November 7th, 1916, another bond issue of $15,000,000 was voted by the State to further prosecute the work of good road building. Then there came an actual craze for good roads in California, and eventually a special election was held and a third bond issue of $40,000,000 authorized.

This building of good roads has only stimulated the use of the public motor truck and auto stage. "Ship-by-truck" has become a popular slogan in California, and the truck and tire interests are boosting the movement with the greatest spirit and vigor.

The problem of the short haul by truck appears to be working out automatically and to be far on the road to solution. The truck as an individual carrier has asserted itself, and nothing appears to threaten its permanency. The truck as a common carrier is still in its experimental stage. But the thing has such great promise, is the subject of so much enthusiastic effort and is surrounded by so much freedom of action that it seems to have a brilliant future.

A Neat Problem in Hydraulics

(Continued from page 198)

walls of steel sheeting at intervals of, say, 300 or 400 feet. The piling was one of the standard forms of rolled sheeting. That is, each pile is a single "plank" of steel without rivets or bolts. The edges are given such forms as to enable each pile to interlock with its companions on the two sides. There are several such varieties of steel sheet piling in use. They are American triumphs in the art of rolling steel. When assembled, the particular size of piling here used provides a covering 14 inches wide per pile.

(Continued on page 212)

LEGAL NOTICES

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IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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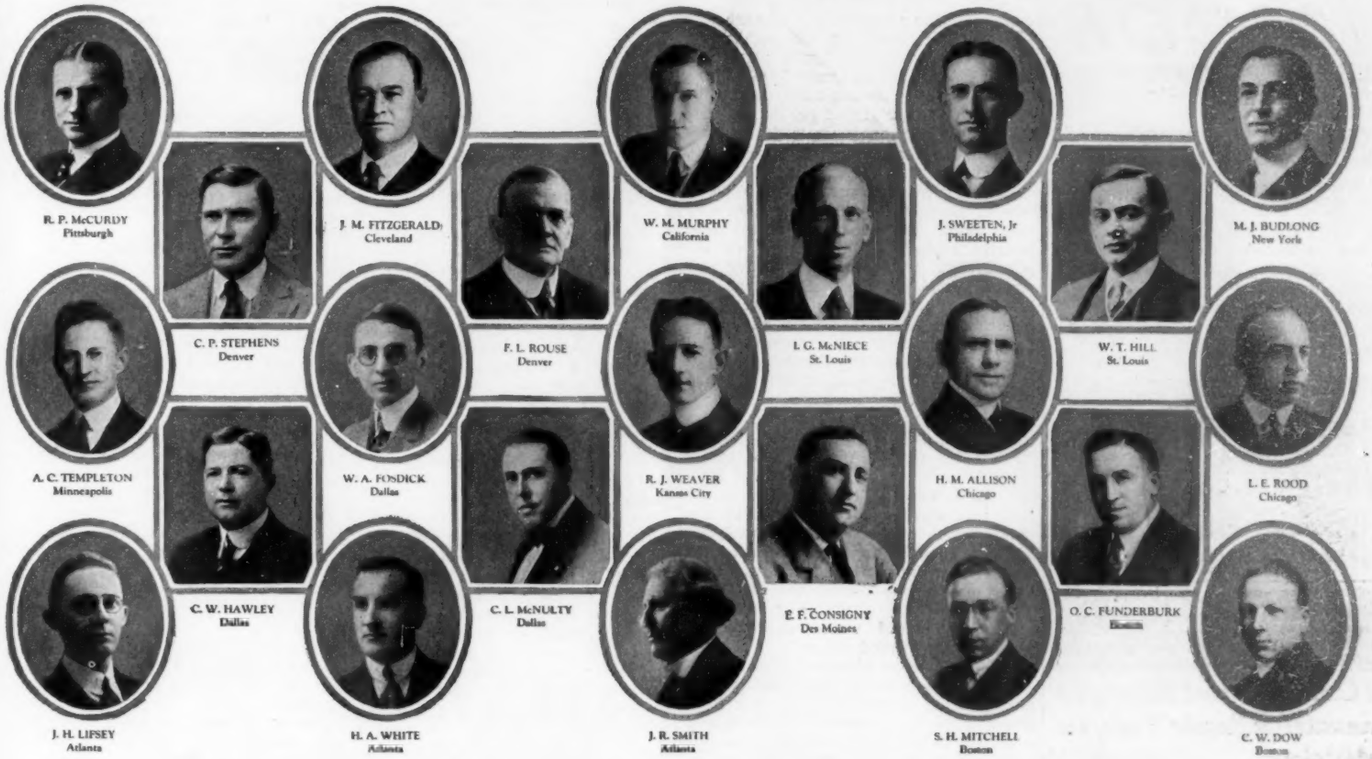

The Men who Distribute the new Leland-built Lincoln Car

Those who know motor cars, know that high character and soundness in the organizations which produce them, should be paralleled by like character and soundness in the organizations which distribute them—the men who form the connecting links or points of contact between the car owner and the manufacturer.

The distributing organizations of the Lincoln Motor Co. are in fifteen cities, including a factory sales branch in Detroit.

As production increases, additional distributors will be selected from the nearly 2,000 applicants already in waiting. Many of these, even now, have lists of priority orders and orders conditional upon their appointment.

In the fourteen cities where sales franchises have been granted, selections were made from among 416 applicants.

In not one single instance was it a matter of soliciting a distributor, nor of accepting whomsoever could be obtained. In every case it was one of our own choosing—of selecting those who we believed to measure up to the standards we had established, and whose high standing in their respective cities had been abundantly tested.

Nor was this a simple procedure, because most of the applicants were distributors well established, of high repute, and already handling cars of the better class. They were men who have made it their business to know motor cars and motor car builders.

With this type of applicants it was a matter of carefully choosing those best qualified.

LELAND-BUILT
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Most of them have had sales franchises continually thrust upon them for consideration, and could obtain almost any franchise merely for the asking.

We have selected organizations and men accustomed to contact with the highest type of citizens—the class to whom the Leland-built Lincoln car will naturally appeal.

They are men cognizant of their responsibilities; men who are not unmindful that upon delivery of a car to the purchaser, their duty has just begun.

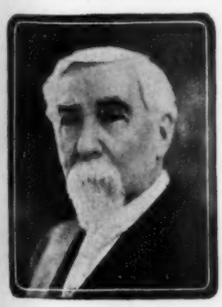
These men have shown the faith that is in them by cooly and deliberately obligating themselves to merchandise millions of dollars worth of motor cars—cars of whose features, and details, and price they were wholly without information.

And their faith is further evinced, in most of the cities, by the erection of modern and adequate structures, quite in keeping with the product and with the clientele.

Their faith in the car, and in the organization which produces it, is confirmed by the faith of more than one thousand of the best citizens who, likewise without definite knowledge of the car, its features, its details, or its price, insisted upon filing priority orders—without encouragement from the factory, and seldom with encouragement from the distributor.

Their faith too, is not without judgment. They know the organization behind the car. They know the character and the accomplishments of the men behind that organization; they know their works and their record; they know their ideals in motor car engineering and motor car construction; they know their forward vision.

Above all, they know the Leland determination and Leland ability to achieve—and to surpass.



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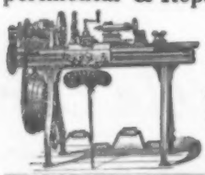

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A Neat Problem in Hydraulics

(Continued from page 210)

Naturally, the actual width of each pile is something in excess. Altogether, the number of lineal feet of piling used for this dock amounts to nearly 75,000. The weight of steel was some 3,100,000 pounds.

It will be remembered perhaps that it was pointed out that strata of hard white sand and cemented gravel overlie the red clay. The driving of the piles through these layers proved very difficult indeed. Some of the piles went down very well; but a large percentage of the total resisted strenuously the efforts of the pile driver. The piling was heavy and strong, weighing about 41 pounds per lineal foot; and yet much of it was later on found to have suffered a good deal from bending and tearing apart. Steel sheeting is ordinarily driven by blows delivered upon its head, usually through an interposed cap. Its stiffness, strength and edge thinness are relied on to secure penetration. As a rule, the pile goes down, cutting its way through the soil and even through buried trees and old lumber. But, here at the Navy Yard, not only was there the combination of the two difficult strata already mentioned, but also big boulders would at times be encountered. Under the almost resistless drive of the pile driver, the steel pile would at times be diverted by a boulder and curl up as if it were a wooden shaving made by a hand plane.

The dock is an enormous box of concrete, and a representative cross-section is not unlike a similar section of a lock. There is the heavy floor of concrete, and the massive side walls of the same material. At Panama the pouring of concrete in the locks was a problem that received more than one solution. At Gatun, the concrete on the very side was handled by cableways stretched transversely across the locks between movable towers shifting lengthwise the site. On the Pacific side, berm cranes serving towers on the center line were employed in at least two pairs of locks. Here in Philadelphia a giant crane not dissimilar to those used with ordinary locomotive crane units was mounted upon a wide-gaged track laid lengthwise of the dock on the one side. One pair of rails was laid on top of the side wall and the other on a concrete stringer supported by bents of bearing piles. This was the arrangement on the west side where the summit of the wall is narrow. On the east side the wall is quite broad. The great boom had a maximum reach of nearly 130 feet at which radius a load of 15 tons could be handled. At a radius of 92½ feet 50 gross tons was a possible load.

What Has Been Said About Einstein

(Continued from page 200)

new and startling when put before us so bluntly as they have been since last December.

He might be a little clearer on some points—notably with regard to the circumstance that the element with which the four-dimensional manifold of space-time is concerned is not the "thing" as he so often has it, but rather the "event." But we would not be understood as criticizing Dr. Slosson's book too severely. It would be extraordinary if no suspicion of technical error were to be found in a discussion so completely and successfully toned down to the popular level. Of its kind this discussion is admirable, and its style is inimitable beyond all adverbial qualification. Our one regret after reading it is that we passed through the mill of Columbia too early to have attended Dr. Slosson's lectures. If he can talk as he writes he must have constant need of a "Standing Room Only" sign such as Dr. Eddington may be pictured as employing when the line of Cambridge students waiting to get into the hall where he was to lecture on Einstein mussed up the entire college grounds. And we may return to the Eddington volume right here to recommend the reading of the delightful three-cornered Socratic conversation between the physicist, the relativist and the mathematician, with which it opens, as an admirable prolog or epilog to the Slosson book.

Other books which have appeared in English for popular or semi-popular consumption might seem to call for attention here. But the fact is we can say nothing good of any of these, and in charity to the publishers who have trustingly supplied us with copies for review it seems unnecessary to say anything bad about any specific one of them. They may reasonably go by default, so far as this review is concerned, hiding their all-too-meager lights under a bushel. A word about magazine articles, however, may not be out of place here. Again it is to be understood that we make no effort to catalog everything that has been published, mentioning only those whose reading seems profitable in connection either with the preparation of an essay for this contest or with the preparation for reading such of these essays as may be published.

Dr. Eddington's article on Einstein in the *Contemporary Review* for December, 1919, is the best that has appeared in English, in our regard. It is fully covered by his book, however, so that one would not care to read the article after having perused or before perusing the book. His article on gravitation in the SCIENTIFIC AMERICAN SUPPLEMENT of July 6th and 13th, 1918, is perhaps a little more out of the track of subsequent discussions, and might well be read by a student of the Einstein doctrines. Of American articles, we prefer those by Dr. Stewart in our own columns under date of January 3rd last, by Mr. Lotka in *Harper's Magazine* for one of the spring months of 1920—the exigencies of going to press do not permit of exact determination of the date—and by Professor Cohen in the *New Republic*. The last named treatment is of value in that it emphasizes as we have seen emphasized in no other place the fact that the present accepted body of Einstein theory is really a composite of three independently promulgated researches—the first and the second, or the restricted and the generalized principles of relativity, and the theory of gravitation. As Professor Cohen says, a great deal of misunderstanding has been created through the overlooking of this circumstance in popular articles by semi-competent writers. But Professor Cohen himself transgresses rather seriously when he comes to discuss the geometric character of the space-time manifold, for he here states as an uncontroverted fact several conclusions on which Dr. Eddington himself was at last accounts not yet ready to express a final opinion.

Einstein himself is responsible for two articles which have been translated from the German in which he wrote them for popular consumption, and which have appeared quite generally in English These are not intelligible to a layman and not of any significance to an informed mathematician. It would appear that the great man is not at home when he tries to stoop to the level of common folk—a common enough phenomenon and one which should never be surprising.

Fire Without Firemen

(Continued from page 202)

such installations that a steady fire, readily under control, be available. With hand firing of coal this would be impossible and fuel oil or gas would have to be used at greater cost.

Just as important as the stoker is the machinery for bringing the coal to the furnace and removing the ashes. At first thought it would seem that this is a simple conveyor problem that might easily be solved in any one of a number of ways. And so it is, in the case of the coal. In many of the large power houses the coal is fed from huge hoppers over the boilers, into which the coal is dumped directly from the cars. Or any one of the standard conveyor systems will prove satisfactory if conditions do not permit the simpler arrangement.

But ash handling presents a more difficult problem for solution. It was once a common practice to use the same conveyor system for both coal and ash but in practically all of the important installations now separate or "divorced" systems are used.

This is because the ashes are never "plain ashes." They are either dripping wet, red-hot, dry and dusty or full of big clinkers. If the ashes are handled wet they pack in conveyor cars and cake there. If they are handled dry a system must be used that will not spread the dust to all parts of the plant. The equipment must be heavy enough to withstand warping from the heat; there must be no exposed bearing or joints to be cut out by the abrasive action of the ash; and above all the conveyor must not consume too much power. In addition there is a safety problem for enclosed ash dust occasionally explodes with disastrous results. The severe conditions which ash conveyors must overcome may be realized from the fact that while the depreciation in ordinary conveying machinery is usually figured at 10 per cent, the depreciation for ash conveyors often is as high as 30 or 40 per cent.

There are six general schemes of ash conveying in general use, each best suited to a peculiar set of conditions. The machine handling of fuel from the car to the ash pile has introduced a multiplicity of problems that must be carefully considered before an installation is made. And so, along with the stoker and conveyor has grown a new profession—that of combustion engineer. Every important boiler plant is now designed by a combustion engineer to fit the peculiar conditions present. He considers the space available, value of the land, the kind of fuel available, boiler capacity, expected overloads, etc. The well-designed plant is a harmonious unit, through which the fuel passes without the expenditure of any manual labor and only the supervision of one or two trained men.

The result is not nearly so picturesque as the glaring furnace door and the half-stripped stoker, but it is much more efficient.

Wood That Is Stronger Than Steel

(Continued from page 204)

by the laboratory experts; one made from the blood of animals and one derived from casein—obtained from milk. Panels were glued together with these and tested in boiling water for eight hours. At the expiration of this time none of the pieces showed any separation of the plies. Soaking in cold water for ten days gave the same results. Finally, tests with a shearing machine, which applied force in such manner as to push one ply from another, were made, and it was demonstrated that a pressure of from two hundred and fifty to seven hundred pounds to the square inch of glue surface was required to separate the layers, so strong were the new glues. As a matter of fact, it was, in most cases, not the glue, but the wood fibers themselves, that gave way.

In considering the application of this new water-proof glue and plywood to industry in our reconstruction period, it becomes evident that an entirely new field has opened for progressive manufacturers of wood articles. Who, till now, has put on the market a standard door that will not warp? Plywood panels cannot warp after they are finished, for one ply holds the next rigidly. What manufacturer has got out a table or chair with glued joints that will not fall to pieces in a damp atmosphere? Furniture made with casein glue will hold together far better.

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THE LIFEBLOOD *of the* NATION IS TRANSPORTATION

Civilization is the process of moving forward—development of resources is the keynote of national and international progress.

Trade is essential to growth and prosperity—yet trade without adequate transportation is dead.

Our railroads are the arteries which supply the nation with bulk transportation—

Trucks are the veins which carry goods from and to the railroad arteries.

Railroads—Trucks—They need each other now.

When the lifeblood stops—the end comes—in humans and in nations.

Freight must be moved faster. Big projects—crops—manufacturing—building—must not be impeded. Progress must go on.

The answer is a better co-ordination of existing transportation facilities and the securing of a complete co-operation between them. Even the war's necessity was not greater than the nation's now.

Therefore, let us arouse ourselves—Let us get the vision of the immense economic loss attendant on this stagnation.

Visualize the waste of holding freight cars—of clogging warehouses and docks—keep the goods moving.

Grasp the portent of idle or broken down railway equipment—of unfilled trucks and crumbling highways.

Do Your Part—Don't Stop the Flow.

How? Move loads faster to destination—Empty cars and trucks quickly—Lay rails and roads where needed—Maintain adequately those now built—Lend or rent your excess transportation units to others—*Keep the Goods Moving.*

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